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# ORGICAL

# SSAYS:

BY

## *A. HUNTER, M. D. F. R. S. L. & E.*

NISI UTILE EST QUOD FACIMUS STULTA EST GLORIA. *Phæd.*

## VOLUME III.

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# *GEORGICAL ESSAYS.*

## ESSAY I.

### *On the Origin and Progreſs of Agriculture.*

THE earth was conſidered by the ancients as the Mother of Plenty. Hence, in the early ages of ſuperſtition and polytheiſm, the firſt libations in their feaſts were offered to her; and thoſe who in any manner diſtinguiſhed the arts of cultivation were numbered among their demigods, or ſecond claſs of deities. They were rewarded with the higheſt honours while living; ſtatues were erected to their memory, and ſacrifices were offered to them, when dead.

But although a conduct ſo extravagant, proved that the minds of the people were groſsly enveloped in the midſt of ſuperſtition, and an almoſt total ignorance of the nature and attributes of a Supreme and Firſt Cauſe, yet it also forcibly indicated the high sense which mankind then formed of the great advantages arising from the arts of cultivation.

In ages of greater refinement, and more general knowledge, the folly of a worship thus groſsly misapplied became so evident, as to occasion its total extermination; but the wisest governments have always regarded Agriculture as an object of the first magnitude and importance, and by various means encouraged and promoted it.

With respect to ourselves, the value of our acres is the grand source of national riches; and this value will ever bear an exact proportion to their cultivation and produce. And therefore, as Agriculture is the basis of our public wealth; and the happineſs of numberleſs individuals, I take the liberty of introducing a brief account of the origin and progreſs of this art in the different ages and nations.

The art of tilling, cultivating, and improving the earth, so as to render it fruitful, claims the precedency of all other arts in point of antiquity as well as dignity. It was man's original employment in the primæval ages of happineſs and peace.

We are told by the Sacred Historian, that Adam instructed his children in this art both by precept and example; and that Cain applied himself to husbandry, whilst Abel led the life of a shepherd, feeding his flocks.

With respect to the methods then used, or the implements employed, we have no information; but when we consider the slow progreſs of the mechanic arts, it is reasonable to suppose, that at a time when the very rudiments of them could scarcely be known, those implements must have been very few and of the simplest kind.

After the deluge had destroyed all the works of men, and swept away every vestige of human art (except the Ark) from the face of the earth, we find it was the first care of Noah and his descendants, to revive the knowledge and practice of husbandry; and to establish them as the first means of obtaining happineſs and plenty in the various countries where they settled.

This art was carried on with the greatest simplicity in those early ages; and it would be a curious speculation to trace it through the slow and almost imperceptible gradations by which it has been brought to its present state of perfection.

With respect to manures, we have little account (except in the Bible) of any being used before the establishment of the Roman empire. In several of the Prophets* we find mention is made of dung and dung-hills, in a manner which indicates that their use in fertilizing land was not wholly unknown.

It is probable, that the inhabitants of those ages which *immediately succeeded* the flood, knew not any method of restoring fertility to an exhausted soil; and this opinion seems warranted by their frequently changing their situation, when the land they occupied failed in yielding its natural produce.

We find that Abraham, and the rest of the Patriarchs, had no long-continued residence on one spot. They applied themselves to a pastoral life; and when their numerous flocks and herds had exhausted the natural produce of one place, they removed to another; ennobling by their example a profeſsion or employment, which afterwards, for several ages, lost its original dignity, by being confined to the lower claſses of the people.

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* See Kings vi. 25. ix. 37.; Jer. viii. 2.; Ps. lxxxiii. 10.; Neh. iii. 13, 14.; Ezra vi. 11.; Isa. xxv. 10.; Lam. iv. 5, &c.

Such was the happineſs and tranquillity enjoyed in this innocent employment, that it gave birth to the finest poetical imagery, and was celebrated under the peculiar distinction of the *Golden Age*.

But as soon as the descendants of Abraham were settled in Palestine, they generally became husbandmen, from the Chiefs of the tribe of Judah to the lowest branch of the family of Benjamin. High birth or rank did not at that time make any distinction; for Agriculture was considered as the most honourable of all employments; witneſs the illustrious examples of Gideon, Saul, and David.

Many paſsages in the Sacred Writings have a strong and beautiful analogy to the sentiments of the heathen poets, in delineating the happineſs enjoyed in those ages of paſtoral and agricultural employment.

The Chaldeans, who inhabited the country where Agriculture had its birth, carried that valuable art to a degree of excellence unknown in former times. They cultivated their lands with great aſsiduity, and seem to have found out some means of restoring fertility to an exhausted soil, by having plentiful harvests in succeſsion; on this account they were not obliged, as their predeceſsors had been, to change their situations, in order to obtain a sufficiency for themselves and their numerous flocks and herds of cattle.

The Egyptians, who, from the natural fertility of their country by the overflowing of the Nile, raised every year vast quantities of corn, were so sensible of the bleſsings resulting from Agriculture, that they ascribed the invention of that art to Osiris.

They also regarded Isis [*], their second deity, as the discoverer of the use of wheat and barley, which before grew wild in the fields, and were not applied by that people to the purposes of food.

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[*] Isis discovered the method of making flour from wheat and barley. DIODOR. SIC.

Their superstitious gratitude was carried so far, as to worship those animals* which were employed in tillage; and even the produce of their lands, as leeks, onions, &c.

The divine honours paid to Bacchus in India, were derived from the same source, he being considered in that country as the inventor of planting vineyards, and the other arts attendant upon Agriculture †.

It is also related of the ancient Persians, on the most respectable authority, that their Kings laid aside their grandeur once every month to eat with husbandmen. This is a striking instance of the high estimation in which they held Agriculture; for at that time arts were practised among that people in great perfection, particularly those of weaving, needle-work, and embroidery.

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* "Teach the dull ox why now he breaks the clod,
"Why now a victim, and now Egypt's God."
POPE.

† According to Arrian and Diodorus Siculus, Bacchus first trained oxen to the plough, and taught men to cultivate the land. He also discovered many of the instruments and conveniencies of agriculture; and for these signal benefits he became so much respected, that he was, by universal consent, raised to the rank of a deity, and received divine worship and solemn sacrifice.

The precepts of the religion taught by their ancient Magi, or Priests, included the practice of Agriculture. The *Saint* among them was obliged to work out his salvation by pursuing all the labours of Agriculture; and it was a maxim of the Zendaveſta, that he who sows the ground with care and diligence, acquires a greater degree of religious merit, than he could have gained by the repetition of ten thousand prayers.

The Phœnicians, so well known in scripture by the name of *Philistines*, were also remarkable for their attention to, and skill in Agriculture. But finding themselves too much disturbed and confined by the incursions and conquests of the Israelites, they spread themselves throughout the greatest part of the Mediterranean islands, and carried with them their knowledge in the arts of cultivation

Mago, a famous General of the Carthaginians, is said to have written no leſs than twenty-eight books on the subject; which Columella tells us were translated into Latin by the expreſs order of the Roman Senate.

Servius confirms this account, and adds, that when Virgil composed his celebrated Georgics, he used these books as a model.

We are informed by the ancient writers, that Ceres was born in Sicily, where she first invented the arts of tillage and of sowing corn. For this eſsential service, she was, agreeable to the superstition of those ages, deified, and worshipped as the goddeſs of plenty.

The truth of this is, that in the time of Ceres, the island, through her endeavours, and the industry of the people, became very fruitful in corn: And Agriculture was there esteemed so honourable an employment, that even their Kings did not disdain to practiſe it with their own hands *.

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* Triptolemus, in particular, who was taught by Ceres the art of sowing corn.

But time, which at first gave birth to arts, often caused them to be forgotten, when they were removed from the place of their origin. The deſcendants of Noah, who settled in Europe, doubtleſs carried their knowledge of Agriculture with them into the regions which they succeſsively occupied. But those who took poſseſsion of Greece were such an uncivilized race, that they fed on roots, herbs, and acorns, after the manner of beasts,

Pelasgus had taught them the culture of the oak, and the use of acorns as food, for which service we are told divine honours were paid him by the people.

The Athenians, who were the first people that acquired any tincture of politeneſs, taught the use of corn to the rest of the Greeks. They also instructed them how to cultivate the ground, and to prepare it for the reception of the seed. This art, we are told, was taught them by Triptolemus. The Greeks soon perceived that bread was more wholesome, and its taste more delicate, than that of acorns and the wild roots of the fields; accordingly they thanked the Gods for such an unexpected and beneficial present, and honoured their benefactor.

As the arts of cultivation increased, and the bleſſings they afforded became generally experienced, the people soon preferred them to whatever the ravages of conquest, and the cruel depredations of savage life, could procure. And accordingly we find that the Athenian Kings, thinking it more glorious to govern a small state wisely, than to aggrandize themselves, and enlarge the extent of their dominions by foreign conquests, withdrew their subjects from war, and mostly employed them in cultivating the earth. Thus, by continued application, they brought Agriculture to a considerable degree of perfection, and soon reduced it to an art.

Hesiod, who is generally thought to have been contemporary with Homer, was the first we know of among the Greeks who wrote on this interesting subject. According to the custom of the Oriental Authors, he wrote in poetry, and embelliſhed his poem with luxuriant description and sublime imagery. He calls his poem "*Weeks and Days*," because Agriculture requires exact observations of times and seasons.

Xenophon has also, in his Economics, remarked, that Agriculture is the nursing mother of the arts. For, say she, "where Agriculture "succeeds prosperously, there the arts thrive; "but where the earth neceſsarily lies unculti"vated, there the other arts are destroyed."

The other eminent Greek writers upon Agriculture were, Democritus of Abdera, Socraticus, Archytas, Tarentinus, Aristotle, and Theophrastus, from whom the art received considerable improvements; as it did alſo from Aieron, Epicharmus, Philometor, and Attalus[*].

The old Romans esteemed Agriculture so honourable an employment, that in the earliest times of the Republic, when patriotism was more than an empty name, the highest praise that could be given a man was to say of him, that he had well cultivated his spot of ground.

A judicious and learned writer[†] has of late very justly remarked, that "One of the most

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[*] Agricult. Dictionary.

[†] Dr. Falconer, in his Remarks on the Influence of Climate, Situation, Way of Life, &c. on the Temper and Manners of Mankind, page 353.

"immediate effects of an agricultural life is, "that it imparts a settled disposition, and a "great degree of local attachment. The very "method also, of procuring subsistence from "the earth, renders the spot which is the "subject of cultivation familiar; and a kind "of natural gratitude for the increase, tends "to endear it to the mind." And that "it "appears to have been a favourite piece of "policy with the Romans, founded on the best "principles, to instill a notion of local attachment as early as poſsible after the commencement of the state."

The most illustrious senators of the empire, in the intervals of public concerns, applied themselves to this profeſsion; and such was the simplicity of those ages, that they aſsumed no appearance of magnificence and splendour, or of majesty, but when they appeared in public. At their return from the toils of war, the taking of cities, and the subduing of hostile nations, their greatest Generals were impatient till they were again employed in the arts of cultivation*. They thought it no disgrace to follow the plough, although they were at the same time prepared to serve the wants of the Republic in every department of the government, to attend her councils, or to put themselves at the head of her victorious legions.

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* For instance, Regulus, Cincinnatus, and divers others.

It must indeed be allowed, that when the Romans became enervated by the fatal introduction of Asiatic luxury, they gradually lost the noble simplicity of their ancestors, and employed their slaves only in the severer labours of a country life. But though they did not *themselves* hold the plough, yet even men of consular dignity looked upon it as a reward for their public services, when they obtained leave to retire into the country; and were equally respected when overlooking their farms, as when seated in the chair of magisterial authority.

Regulus, a celebrated Roman commander, when in Africa, requested of the Senate to be dismiſsed, lest his *farm* might suffer for want of proper cultivation in his absence; and the Senate wrote him for answer, that it should be taken care of at the public expense, while he continued to lead their armies.

The ancients appear to have entertained an uniform sense of the influence an agricultural life had on the manners and morals of the people.

Alexander built cities for the Indian nations, that they might employ themselves in husbandry, and becoming thereby poſseſsed of property, which naturally suggested a care for its preservation, they might on that account be more cautious of offering injury or violence to others[*].

Cicero expreſsed an high opinion of the good effects of an agricultural life on the manners and conduct, in his work, *de Senectute, et pro L. Roseio Amerino.*

And Strabo tells us, that those who practised agriculture in India, were the most moral and just of any ranks of the people.

Cato the Censor, that illustrious Roman general, politician and lawyer, after having governed extensive provinces, and subdued many warlike nations, did not think it below his dignity to write a Treatise on Agriculture. This work (as we are told by Servius) he dedicated to his own son; it being the first Latin treatise written on this important subject. This book has been handed down to us in all its purity, in the manner that Cato wrote it.

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[*] History of India.

Varro composed a treatise on the same subject, and on a more regular plan. This work is embellished with all the Greek and Latin erudition of that learned author, who died 28 years before the commencement of the Christian æra.

Virgil, who lived about the same time, has adorned this subject with the language of the Muses, and given it inexpreſsible grace, beauty, majesty, and dignity, by his verse. In his Georgics, he has finely embellished the precepts and rules of Husbandry left by Hesiod, Varro, and Mago.

Columella, who flourished in the reign of the emperor Claudius, wrote twelve books on husbandry, replete with important instruction.—He was a native of Bœotia in

Spain, and had devoted the principal part of his time to the study of agriculture.

This art received likewise great improvement from the two Safferna, Scorfa, Tremellius, and Tirentius.

Palladius also wrote several treatises on the same subject.

From this period to that of the reign of Constantine Poganatus, husbandry continued in a declining state; but that wise Emperor caused a large collection of the most useful precepts relating to agriculture to be extracted from the best writers, and published them under the title of Geoponics. It has been aſserted, that he made this collection with his own hand; and the truth of the aſsertion is not improbable, as it is well known, that after he had conquered the Saracens and the Arabians, he not only practised and encouraged, but studied the arts of peace, fixing his principal attention on agriculture, as their best foundation.

But after the death of Constantine, the increasing attention of the people to commerce, and the ignorance and groſs ſuperſtition of the ages which ſucceeded, ſeems to have rendered agriculture an almoſt neglected ſcience. We find no veſtiges of any thing tolerably written on the ſubject. No new attempts were made to revive it, or to improve it, till the year 1478, when Creſcenzio publiſhed an excellent performance on the ſubject at Florence. This rouſed the ſlumbering attention of his countrymen, ſeveral of whom ſoon followed his example. Among theſe, Tatti, Steffano Auguſtina Gallo, Sanſovino, Lauro, and Tarello, deſerve particular notice.

But to return to our own country.

We are very much in the dark with reſpect to the ſtate and progreſs of agriculture in Great-Britain previous to the fourteenth century. That it was pretty generally practiſed, eſpecially in the eaſtern, ſouth, and midland parts of England, is certain; but of the mode, and the ſucceſs, we are left almoſt totally ignorant. In the latter end of the fifteenth century, however, it ſeems to have been cultivated as a ſcience, and received very great improvement.

At this time our countryman Fitzherbert, Judge of the Common-Pleas, shone forth with distinguished eminence in the practical parts of husbandry. He appears to have been the first Englishman who studied the nature of soils, and the laws of vegetation, with philosophical attention. On these he formed a theory confirmed by experiments, and rendered the study pleasing as well as profitable, by realizing the principles of the antients, to the honour and advantage of his country. Accordingly, he published two treatises on this subject; the first, entitled "*The Book of Husbandry,*" appeared in 1534; and the second called "*The Book of Surveying and Improvements,*" in 1539.

These books, being written at a time when philosophy and science were but just emerging from that gloom in which they had long been buried, were doubtleſs replete with many errors; but they contained the rudiments of true knowledge, and revived the study and love of an art, the advantages of which were obvious to men of the least reflection. We therefore find that Fitzherbert's books on agriculture soon raised a spirit of emulation in his countrymen, and many treatises of the same kind succeſsively appeared, which time has however deprived us of, or at least they are become so very scarce as only to be found in the libraries of the curious.

About the year 1600, France made some considerable efforts to revive the arts of husbandry, as appears from several large works, particularly, *Les Moyens de devenir Riche*; and the *Cosmopolite*, by Bernard de Paliſsy, a poor porter, who seems to have been placed by fortune in a station for which nature never intended him; *Le Theatre d'Agriculture*, by Deserres; and *L'Agriculture et Maison Rustique*, by Meſsrs. Etienne, Liebault, &c.

Nearly in the same period, the *practice* of husbandry became more prevalent among this people and the Flemings, than the publishing of *books* on the subject. Their intention seemed to be that of carrying on a private lucrative employment, without instructing their neighbours. Whoever therefore became desirous of copying their method of agriculture, was obliged to visit that country, and make his own remarks on their practice.

The principal idea they had of husbandry was, by keeping the lands clean and in fine tilth, to make a farm resemble a garden as nearly as poſsible.

Such an excellent principle, at first setting out, led them of course to undertake the culture of *small farms* only, which they kept free from weeds, continually turning the ground, and manuring it plentifully and judiciously. When they had by this method brought the soil to a proper degree of cleanlineſs, health, and sweetneſs, they chiefly cultivated the more delicate graſses, as the surest means of obtaining a certain profit upon a small estate, without the expense of keeping many draught horses and servants. A few years experience was sufficient to convince them, that ten acres of the best vegetables for feeding cattle, properly cultivated, would maintain a larger stock of grazing animals, than forty acres of common farm graſs on land badly cultivated. They also found, that the best vegetables for this purpose were lucerne, sainfoin, trefoil of most kinds, sweet fenugreek, buck and cow-wheat, field turnips, and spurrey.

The grand political secret of their husbandry, therefore, consisted in letting farms on improvement. They are said also to have discovered nine sorts of manure, but what they all were, we are not particularly informed. We find, however, that marl was one of them, the use and virtues of which appear also to have been well known in this kingdom two hundred years ago *, although it was afterwards much neglected. They were the first people among the moderns, who ploughed in green crops for the sake of fertilizing the soil; and who confined their sheep at night in large sheds built on purpose, the floors of which were covered with sand or virgin earth, &c. which the shepherd carted away each morning to the compost dunghill.

Let us now return to England. During the reign of Charles the First, our fatal domestic diſsensions and wars reversed the true order of things, changing our ploughs and pruning-hooks into martial weapons. But in the general revolution of affairs, which took place on the death of that unfortunate Monarch, artful and avaricious men crept into the con-

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* See Fitzherbert and Tuſser.

fiscated estates of such of the nobility and gentry as had steadily adhered to the royal cause; and as many of these *new* incroachers *had risen* from the plough, they returned with pleasure to their old occupations, being chiefly animated with the love of gain. About this time, Tufser, Platt, Plattes, Hartlib, Blythe, and some others, seized this favourable opportunity of encouraging the disposition of the common people, by writings, which have been equalled by few in later times.

This revival of the art of husbandry received very considerable encouragement from Cromwell himself.

Sir Hugh Platt was one of the most ingenious husbandmen of the age in which he lived; yet so great was his modesty, that all his works, except his Paradise of Flora, seem to be posthumous. He held a correspondence with most of the lovers and patrons of agriculture and gardening in England; and such was the justice and modesty of his temper, that he always named the author of every discovery communicated to him. Perhaps no man in any age discovered, or at least brought [illegible] kinds of manure. This [illegible] those who read his account [illegible] and covered dung-hills, and [illegible] observations on the following [illegible] in salt, street-dirt, and the [illegible] in great cities, clay, fuller's-earths, dung-hills made in layers, [illegible] mation of all vegetables, malt-[illegible] earth, soaper's ashes, urine, [illegible] pilchards.

[illegible] Plattes may be ſaid to have been [illegible] genius in husbandry. He began his observations at an early period in the reign of Queen Elizabeth, and continued [illegible] down to the Commonwealth. But notwithstanding the great merit of this writer, and the eſſential service he had rendered his country by his writings, the public ungratefully suffered him to starve and perish in the streets of London, nor had he a shirt on his back when he died.

Samuel Hartlib, a celebrated writer on agriculture in the last century, was highly esteemed and beloved by Milton, and other great men of his time. In the preface to the work entitled *his Legacy**, he laments that no public director of husbandry was established in England by authority; and that we had not adopted the Flemish method of letting farms upon improvement.

This remark of Hartlib's procured him a pension of 100l. a year from Cromwell; and the writer afterwards, the better to fulfil the intention of his benefactor, procured Dr. Beatti's excellent annotation on the Legacy, with other valuable papers from his numerous correspondents.

The time in which Hartlib flourished, seems to have been an æra when the English husbandry rose to great perfection, compared with that of former ages; for the preceding wars had impoverished the country gentlemen, and of course made them industrious. They found the cultivation of their own lands to be the most profitable station they could fill; but this wise turn was not of long continuance. At the Restoration, they generally became infected with that intoxication and love of pleasure which succeeded. All their industry and knowledge were exchanged for neglect and diſsipation; and husbandry descended almost entirely into the hands of common farmers.

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* It must be here observed, that the famous work attributed to Hartlib, and called *his Legacy*, was not written by him. It was only drawn up at his request by one R. Childs, and after undergoing Hartlib's correction and revisal, was published by him. It consists of a general answer to this question; "What are the "actual defects and omiſsions, and what the poſsible im"provements, in English husbandry."

In that age of unrestrained indulgence, when vice and folly were pursued to the exclusion of almost every thing serious and truly interesting, Evelyn was the first writer who inspired his countrymen with a desire of reviving the study of agriculture. He was followed by the famous Jethro Tull. And their joint labours opened a new and extensive sphere for the minds of mankind to range in.

Evelyn, by his admirable Treatises on earth and on planting, and Tull, by showing the superior advantages of the drill-husbandry, excited numbers to bring their theory to the test of fair experiment; and the succeſs that attended it, proved the rectitude of their general principles, and the solidity of their reasoning.

Many valuable and capital improvements have since that period been made in English husbandry; and these great men have been succeeded by a variety of writers, many of whom have done eſsential service, by enlightening the minds of their countrymen, and exciting them to emulation.

About the middle of the last century, Ireland began to make a considerable figure in the art of husbandry. It must, indeed, be confeſsed, that the Irish had very strong prejudices in favour of a wretched method of agriculture, till Blythe opened their eyes by his excellent writings. Since that time, a spirit of improvement has more or leſs been promoted, and in many instances carried on with great zeal, by the nobility, clergy, and gentry of that kingdom.

In proof of this, it will be sufficient to observe, that the transactions of the Dublin Society for encouraging husbandry are now cited by all foreigners, in their memoirs relating to that subject. And the observations of that discerning and judicious writer, Arthur Young, Esq. in his late Tour through that kingdom, show, that, in many respects, improvements there have of late years made a progreſs nearly as rapid as in England.

After the peace of Aix-la-Chapelle, most of the nations of Europe, by a sort of tacit consent, applied themselves to the study of agriculture, and continued to do so, more or leſs, amidst the universal confusion that succeeded.

The French found by repeated experience, that they could never maintain a long war, or procure a tolerable peace, unleſs they could raise corn enough to support themselves in such a manner as not to be obliged to harsh terms on the one hand, or to perish by famine on the other. This occasioned the King to give public encouragement to agriculture, and even to be present at the making of several experiments. The great, and the rich, of various ranks and stations, followed his example; and even the ladies were candidates for a share of fame in this public-spirited and commendable undertaking.

During the hurry and distreſses of France in the war of 1756, considerable attention was paid to agriculture. They felt the effects, and saw the neceſsity of promoting it. Prize questions were annually proposed in their rural academies, particularly those of Lyons and Bourdeaux; and many judicious alterations were made by the Society for improving agriculture in Britanny.

Since the conclusion of that war in 1760, matters have been carried on there with great vigour. The University of Amiens made various proposals for the advancement of husbandry; and the Marquis de Tourbilly (a writer who proceeded chiefly on experience) had the principal direction of a Georgical Society established at Tours.

The Society at Rouen also deserves notice; nor have the King of France and his Ministers thought it unworthy their attention. There are at present about fifteen Societies existing in France, established by royal approbation, for the promoting of agriculture; and these have twenty co-operating Societies belonging to them.

About this time vigorous exertions began to be made in Ruſsia to introduce the most approved system of husbandry which had taken place in other parts of Europe. The preſent illustrious Empreſs of that vast and rising Empire, has sent several gentlemen into England and other nations, to study Agriculture, and is giving it all poſsible encouragement in her own dominions.

The art of agriculture has also been for near thirty years publicly taught in the Swedish, Danish, and German Universities, where the Profeſsors may render effectual service to their respective countries, if they understand the practical, as well as the speculative part, and can converse with as much advantage with the farmer as with Virgil and Columella,

Even Italy (sunk as it is in luxury and the enervating arts of pleasure) has not been totally inactive. The Neapolitans of this age have condescended to recur to the first rudiments of revived husbandry, and begun to study anew the Agricultural System of Crescenzio, first published in 1478.

The people of Bergamo have pursued the same plan, and given a new edition of the Ricordo d'Agriculture de Tarello, first published in 1577.

The Duchy of Tuscany have, to their honour, imbibed the same spirit for improvement. A private gentleman, above forty years since, left his whole fortune to endow an Academy of Agriculture. The first Ecclesiastic in the Duchy is president of this society, and many of the chief nobility are members.

Animated with a desire that the people under his government should excel in the art of husbandry, his Sardinian Majesty has also sent persons to learn the different modes of practice in foreign countries; and made some spirited attempts to establish a better method of Agriculture among his subjects.

In Poland, where a natural fertility of soil seems to dispense with the neceſsity of calling in the aid of improvements, M. De Bieluski, grand Marshal of the Crown, has made many succeſsful attempts to introduce the new husbandry among his countrymen; and procured the best instruments for that purpose from England, France, and other parts of Europe.

The Hollanders are the only people now in Europe who seem to look upon agriculture with indifference. Except the single collateral instance of draining their fens and moraſses, they have scarcely paid any attention to it; and even this seems to have proceeded more from the motive of self-preservation, than any love of or disposition to husbandry.

In the year 1759, a few ingenious and public-spirited men at Berne, in Switzerland, established a Society for the advancement of Agriculture and Rural Œconomics. In that society were many men of great weight in the republic, and most of them persons of a true cast for making improvements in husbandry, being enabled to join the practice with the theory.

Nor must we here omit to mention, that the justly celebrated Linnæus and his disciples have performed great things in the north of Europe, particularly in discovering new kinds of profitable and well-tasted food for cattle.

About the same time, Sweden largely augmented a commerce that had long been confined within narrow bounds; and with a spirit worthy of general imitation, bestowed succeſsful labours on a soil, which had before been looked upon as cold, barren, and incapable of melioration. Of this the Stockholm Memoirs will be a lasting monument.

Denmark, and many of the courts in Germany, followed the same example: Woollen manufactures were encouraged; and his Danish Majesty sent three persons into Arabia Felix to make remarks, and bring over such plants and trees as would be useful in husbandry, building, and rural affairs.

The Duchy of Wirtemburgh also, a country by no means unfertile, but even friendly tocorn and pasturage, has contributed its aſsistance towards the improvement of Agriculture, having more than thirty years since published fourteen œconomical relations at Sturgard.

Nor must we forget the very aſsiduous attention of the learned in Leipsic and Hanover to this great art of supporting and rendering mankind happy, wealthy, and powerful.—During the rage and devastation of a long war, they cultivated the arts of peace; witneſs the *Journal d' Agriculture*, printed at Leipsic, and the *Recueils d' Hanover*, printed in that city.

Even Spain, constitutionally and habitually inactive on such occasions, in spite of all their natural indolence, and the prejudices of bigotry, invited Linnæus, with the offer of a large pension, to superintend a college founded for the purpose of making new inquiries into the History of Nature, and the Art of Agriculture.

But without any improper partiality to our own country, we are fully justified in aſserting, that England alone exceeds all modern nations in husbandry. To the natural genius of the people, have been added the theory and practice of all nations in ancient and modern times. This accumulated maſs of knowledge has been arranged, divided, and subdivided; and after paſsing the test of practical experiments, the eſsential and most valuable parts of it have been preserved and amply diffused in the works of a few excellent writers on the subject. And from the spirit which for the last twenty years has animated many of our nobility and gentry, to become the liberal patrons of improvement, there is reason to hope, that this most useful of arts will, in a few years, be carried to a greater pitch of perfection, than it has ever yet attained in any age or country.

The very respectable societies which have been established on the most liberal plans in London, and divers other parts of this nation, have made spirited exertions for the advancement of Agriculture. They have already done much, and there is reason to expect, that the opportunity and aſsistance which the restoration of peace affords, will enable them to do much more of what remains to be accomplished.

But it is not to the exertions of public societies, excellent and honourable as they are, that *all* our modern improvements in Agriculture owe their origin. A considerable number of valuable books have within the last thirty years been published on the subject; in consequence of which the knowledge of Improvements made in this and other nations have been amply spread, which might otherwise have remained confined to a single county, or even a still smaller district. Among these the works of Lord Kaimes, Mr. Young, Stillingfleet, Dr. Hunter, Ellis, Randal, Lisle, Clarke, Marshal, Mortimer, Baker, Varley, Harte, Duhamel, Bradley, Kent, De Turbilly, Mills, and others have greatly tended to enlighten the understandings of such as read them, and to remove the deeply-rooted prejudices in favour of ancient modes of practice, which farmers in general are too apt to entertain.

# ESSAY II.

## *On Vegetation.*

THE object of any inquiry into the nature and principles of Vegetation, *for practical purposes,* must be, to ascertain in what manner those plants, which are neceſsary for the use of man, can be most easily cultivated to perfection. For that purpose it is eſsential to know, what agents are neceſsary or uſeful, and what are destructive or injurious to vegetation.— The former may be considered under the following general heads, namely, Earth or Soil, Air, Water, Light or Heat, Manures or dead organized Matter, and Cultivation. The latter may be restricted to two points, to wit, mineral or noxious substances in the soil, and vermin.

### I. *The Agents which are neceſsary or uſeful to Vegetation, are,*

1. *Earth.*—The neceſsity of soil, for the growth of plants in general, not only for the purpose of holding them steady and upright

to grow, and to receive whatever nourishment the air affords, but also for containing at least some part of the food on which they live, is sufficiently obvious. Many aquatic plants, indeed grow in water, but the greater part of them have their roots in earth. Marine plants, it is true, grow upon bare rocks, or stones; but then it is well known that they are fixed to them, and that they derive their food from the sea-water in which they live. Some authors have contended, that plants are actually nourished by the earth alone. But such an idea is sufficiently refuted by various experiments.

2. *Air*.—This agent seems to be another eſsential requisite to the growth of plants; and air at a distance from towns, is also neceſsary for bringing some of them to perfection. There are many trees and plants, that will not grow in the contaminated air of large towns, but thrive at three or four miles distance. Many kinds of fruit trees, will not bear good fruit in the immediate neighbourhood of the metropolis. Pure atmospheric air seems to be as neceſsary for the healthineſs of plants, as for that of man.

Of late, indeed, some respectable philosophers, have entertained an idea, that atmospheric air, is the sole, or at least, the principal food of plants. Some decisive experiments, in regard to that doctrine, seem to be wanting. Trees extending their branches in the air, were not, probably, furnished with foilage for ornament merely. Their leaves, indeed, seem to be analogous to the lungs of animals, and act in the same way. The advantage of fallowing also, according to some, proves that the earth extracts nourishing particles from the air, and is *fertilized* by its influence.

3. *Water.*—That water is eſsential to vegetation, seems to be on all hands acknowledged. Indeed many contend, that it is the sole food of plants. It certainly supplies the principal materials of the sap which may be called the blood of plants, without which they would perish; many instances being known of trees dying, whose sap was exhausted. The great improvements which are made by the mere watering of land, prove the powerful effects of water. But it seems more favourable to the growth of graſses than of grain, for though, by irrigation, perpetual crops of graſs could be obtained, yet it has been found, by experience,

that land, if cropt with grain, was completely exhausted, though regularly watered, which could not have been the case if water was the sole food of plants. It is certain, however, that a large proportion of every plant consists of water, and that water is the vehicle, by which all the food, which the plant receives from the root, is conveyed to it. However beneficial water is, all spring waters are not equally so. Some waters are certainly hurtful, particularly to young plants. Mineral waters, as that of Cheltenham, &c. are known, by experience, to be injurious.

4. *Light and Heat.*—Light and heat, (or the matter of heat, as some philosophers call it) are, perhaps, not so neceſsary for the growth of plants, as eſsential for their attaining perfection. Plants will grow in the dark, as in mines and cellars, but few of them bring their seeds to perfection in that state. Light is certainly neceſsary to give them their natural colour and proper flavour. Plants are said to be so fond of light, that if put into a dark place, they will always bend towards a hole or window where the light is admitted. Few plants are calculated for very cold countries, and those are seldom valuable. Heat is certainly ne-

ceſsary to bring fruits to perfection, and wherever there is the most heat or light, there the fruit, or seed of the plant, will have the greatest quantity of saccharine matter. Hence, English barley, of equal weight, is more valuable than Scotch, producing a greater quantity of malt liquor, or of spirits. Plants which seem dead from the severity of cold seasons, are revived by the warmth of the spring; are strengthened by the heat of summer, and acquiring fresh life and vigour, are enabled to withstand the rigours of the succeeding winter.

5. *Manures, or dead organized Matter.*—It seems to be a part of the beautiful Œconomy of Nature, that nothing should have lived in vain, and that the destruction of one plant, or animal, should furnish food for others. Hence, however useful earth, air, water, and light, are, to the growth of plants, it is, if not certain, at least questionable, whether they could ever come to perfection, without the aid of matter that had been formerly organized. The richest soils, it is well known, are full of dead animal and vegetable matter, and there is no soil that will not produce plants, if a sufficient quantity of dead animal or vegetable sub-

stances be added to it. Under this head is comprehended; all those manures which are found so useful in cultivation, more especially those to which some authors give the name of mucilaginous, enriching, or nutritious.

It might here be expected that some allusions would have been made, to those saline substances, on the advantages of which some authors have laid so much weight. But salt does not seem eſsential to the growth of any species of plants, the marine alone excepted; and there are many productive soils in which little, or no salt, can be traced. Salt, however, is of use to vegetation, though not eſsential to it. It may operate upon plants as it does upon the human body, by aſsisting to digest the food, without furnishing nutriment itself. It is of use, mixed with dung, as an aſsistant to putrefaction. It is also serviceable by attracting moisture, destroying vermin in the soil, and putrifying the roots of any plants it first meets with, thus furnishing nourishment to the succeeding ones.

6. *Cultivation.*—The culture of the earth is eſsentially neceſsary for the growth of plants to perfection. By dividing the particles of the

soil, the roots can more easily penetrate it, and they can more readily suck in the nourishment which it contains. By proper culture also, weeds, or useleſs plants, are extirpated, whilst stirring the earth admits more air and moisture to those which have been sown. Young trees certainly thrive much better, if the soil in which they are planted has been previously ploughed so deep, as readily to admit their roots and suckers. Even after they are planted, it is supposed to be of great service, to cultivate potatoes and other roots among the young plantations, with a view to kill weeds, and loosen the soil for the free admiſsion of air and water. This practice seems to be generally well received.

### 2. *The Agents which are destructive, or injurious to Vegetation are,*

1. *Mineral, or noxious Substances in the Soil.*—There are certainly many substances in the soil, noxious to vegetation, in particular, those of a metallic nature. Where mines of iron, lead, or copper, are near the surface, no plants will grow to perfection, which is well known to be the case in mining districts. *Schistus*, in which generally there is a great deal of iron and alum, is so unfavourable to

vegetation, that any considerable quantity of it would destroy the fertility of the richest soil. Fallowing, or exposure to the air, and the use of lime, will it is supposed, correct the the noxious qualities of those substances.

There is also an astringency or acidity in peat, so noxious to vegetation, that until any quality of that nature is subdued, though that species of soil be a maſs of vegetable matter, yet nothing but heath and other miserable plants will grow in it.

2. *Vermin.*—Plants are also much injured, by the various sorts of vermin with which both the earth and the air abound. Those which inhabit the earth, it is supposed, may be destroyed by salts, by acids, or by lime. In regard to the myriads of insects with which the air abounds, it is more difficult to point out a remedy. It is said, that in some parts of the continent, they surround their gardens with a broad row, or belt of hemp, the smell of which is particularly noxious to insects. As every kind of fruit-tree seems to have its peculiar insect, might not the parent insect be prevented from laying its eggs on these trees, by hanging on their branches pieces of

cordage dipped in tar; and this upon the general supposition, that the winged insects make their election by the smell? In Thunberg's Travels, we are told that the celebrated Bergman prevented the Phalæna brumata from laying its eggs in the bloſsoms of fruit trees, by tying the tarred bark of a birch round their stems. Sometimes vermin are occasioned by the weakneſs of the plant, and the poverty of the soil in which it grows. This is supposed to have been the case in regard to the celebrated Heſsian fly of America, which originated from bad culture during the war, in consequence of which, the wheat became diseased. It vanished with good cultivation; and indeed it is aſserted, that fields, properly manured, were never affected by it, though in the immediate neighbourhood of those which were.

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## ... III.

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...

... of our plantations is on that
... Nottinghamshire is generally
... the name of forest-land. It
... of hills and dales.. In some
... are very steep and high; but
... ascents are gentle and easy.
... of a mixture of sand and
... abound most with the latter,
... with the former, as the smaller
... by the wind and rains, brought

from time to time, from the high grounds to the lower. It is on the hilly grounds we make our plantations, which in time will make the valleys of much greater value, on account of the shelter they will afford.

After his Grace has fixed on such a part of this forest-land as he intends to have planted, some well-situated valley is chosen (as near the centre of the intended plantations as may be) for the purpose of a nursery: if this valley is surrounded with hills on all sides but the south, so much the better. After having allotted a piece of ground, consisting of as many acres as is convenient for the purpose, it is fenced about in such a manner as to keep out all obnoxious animals. At both ends of the nursery are large boarded gates, as also a walk down the middle, wide enough to admit carriages to go through, which we find exceedingly convenient when we remove the young trees from thence to the plantations. After the fence is completed, the whole is trenched (except the walk in the middle) about twenty inches deep, which work may be done for about three pounds ten shillings, or four pounds, per acre, according as the land is more or leſs gravelly: this work is best done in the spring when the planting season is over. If, after the trenching, two or three chaldrons of lime be laid on an acre, the land will produce an excellent crop, either of cabbages or turnips, which, being eaten off by sheep in the autumn, will make the land in fine order for all sorts of tree-seeds: but as the Oak is the sort of tree we cultivate in general, I shall confine myself particularly to our present method of raising and managing that most valuable species.—In the autumn, after the cabbages or turnips are eaten off, the ground will require nothing more than a common digging. So soon as the acorns fall, after being provided with a good quantity, we sow them in the following manner: draw drills with a hoe in the same manner as is practised for pease, and sow the acorns therein so thick as nearly to touch each other; leave the space of one foot between row and row, and between every fifth row allow the space of two feet for the alleys. While the acorns are in the ground, great care must be taken to keep them from vermin, which frequently will make great havock amongst the beds, if not timely prevented.—Let this caution serve for most other sorts of tree-seeds.

After the acorns are come up, the beds will require only to be kept clean from weeds till they want thinning; and as the plants frequently grow more in one wet season, where the soil is tolerably good, than in two dry ones, where the soil is but indifferent, the time for doing this is best ascertained by observing when the tops of the rows meet. Our rule is to thin them then, which we do by taking away one row on each side the middlemost, which leaves the remaining three rows the same distance apart as the breadth of the alleys. In taking up these rows we ought to be anxiously careful neither to injure the roots of the plants removed, nor of those left on each side. The rest of the young Oaks being now left in rows at two feet apart, we let them again stand till their tops meet; then take up every other row, and leave the rest in rows four feet asunder, till they arrive to the height of about five feet, which is full as large a size as we ever wish to plant. In taking up the two last sizes, our method is to dig a trench at the end of each row full two feet deep, then undermine the plants, and let them fall into the trench with their roots entire.

And here let me observe, that much, very much, of their future ſucceſs depends on this point of their being well taken up. I declare that I should form greater hopes from one hundred plants well taken up and planted, than from ten times that number taken up and planted in a random manner: besides, the frequent loſs of the plants makes the worst method the most expensive.

But before I leave this account of our method of raising Oaks, I shall just beg leave to observe, that we are not very particular in the choice of acorns. In my own opinion it matters not from what sort of tree the acorns are gathered, provided they are good; for although there seems to be a variety of the English Oak, in respect to the form of the leaf and fruit, also their coming into leaf at different seasons, with some other marks of distinction, yet I am of opinion that they will all make good timber-trees if properly managed: it is natural to suppose that a tree will grow low and spreading in a hedge-row; on the contrary, it is very improbable that many should grow so in a thick wood, where, in general, they draw one another up straight and tall. And I have observed that the same distinctions hold good amongst our large timber-trees in the woods, as in the low-spreading oaks in the hedge-rows.

Though I have not as yet taken notice of any other sort of tree but the Oak, yet we have a great regard for, and raise great quantities of Beech, Larch, Spanish Chesnut, Weymouth Pine, and all sorts of Firs, the Scotch excepted, as well as many other kinds, by way of thickening the plantations while young; amongst which the Birch has hitherto been in the greatest estimation, it being a quick growing tree, and taking the lead of most other sorts on our poor forest hills; and as we have an inexhaustible spring of them in the woods, where they rise of themselves in abundance from seed, we at all times plant them plentifully of different sizes. As to the Elm and Ash, we plant but few of them on the forest, though we raise great quanties of both, but particularly the Ash, which being a useful wood (but a bad neighbour amongst the Oaks) we plant in places apart by itself.—I shall dismiſs this subject concerning the management of our nurseries, after saying a word or two relating to pruning: We go over the whole of the young trees in the nursery every winter; but in this we do little more than shorten the strong side-shoots, and take off one of all such as have double leads.

Having thus pointed out the mode of forming and managing our nurseries, I shall now proceed to the plantations.—The size of the plantations, at first beginning, must be in proportion to the stock of young trees in the nursery; for to undertake to plant more ground than we have young trees to go through with for thick plantations, would turn to poor account on our forest hills. We always plant thick, as well as sow plentifully at the same time, provided it be a season in which acorns can be had; so that all our plantations answer in a few years as nurseries to succeeding plantations.

As to the form of the plantations they are very irregular: we sometimes follow a chain of hills to a very great distance; so that what we plant in one season, which perhaps, is sixty, eighty, and sometimes an hundred acres, is no more than a part of one great design.

If the ground intended to be planted has not already been got into order for that purpose, it should be fenced about, at least a twelvemonth before it is wanted to plant on, and immediately got into order for a crop of turnips. Two chaldrons of lime being laid on an acre will be of great service, as it will not only be a means of procuring a better crop of turnips, but will bind the land afterwards and make it fall heavy, which is of great use when it comes to be planted, as some of the forest land is so exceedingly light as to be liable to be blown from the roots of the young trees after planting: therefore we find it to be in the best order for planting about two years after it has been ploughed up from pasture, before the turf is too far gone to a state of decay. It will be neceſsary to have a part of the turnips eaten off soon in the autumn, in order to get the ground into readineſs for early planting; for we find the forward planting generally succeeds the best.

After the turnips are eaten off, we plough the ground with a double-furrow trenching plough made for that purpose, which, drawn by six horses, turns up the ground completely to the depth of twelve or thirteen inches.— This deep ploughing is of great service to the plants at the first, and also saves a great deal of trouble in making the holes. After the ploughing is finished, we divide the ground into quarters for the planting by ridings. It will be a difficult matter to describe the laying out the ground for this purpose, especially where there is such a variety of land as we have on the forest: much depends on the taste of the person employed in this office. Between the hills, towards the outsides of the the plantations, we frequently leave the ridings from sixty to an hundred yards in breadth, and contract them towards the middle of the woods, to the breadth of ten or twelve yards; and on the tops of the hills where there are plains, we frequently leave lawns of an acre or two, which makes a pleasing variety.

In some of them we plant the Cedar of Libanus at good distances, so as to form irregular groves: and this sort of tree seems to thrive to admiration on the forest-land. On the outsides of the woods, next to the ridings, we plant evergreens, as Hollies, Laurels, Yews, Junipers, &c. and these we dispose of in patches, sometimes the several sorts entire, at other times we intermix them for variety; but not so as to make a regular screen or edging. Our design in the distribution of these plants, is to make the outsides of the woods appear as if scalloped with evergreens, intermixed sometimes with rare trees, as the *Liriodendron Tulipifera*, or Virginian Tulip-tree, &c.

After the ground is laid out into quarters for planting, we aſsign certain parts to Beech, Larch, Spanish Chesnuts, &c. These we plant in irregular patches here and there throughout the plantations, which when the trees are in leaf, has the most pleasing effect, on account of the diversity of shades; especially in such parts of the forest where, four, five, and sometimes more of the large hill-points meet in the same valley, and tend, as it were, to the same centre.

After those patches are planted, or marked out for that purpose, we then proceed to the planting in general. We always begin with planting the largest young trees of every sort, and end our work with those of the smallest size. Were we to proceed otherwise, the making a hole for a larger-sized tree, after the small ones are thick planted, would cause the greatest confusion.

Birch is generally the sort of tree we

[illegible] beginning with, which we find will be removed with great safety, at the [illegible] six or seven feet, though we commonly [illegible] rather under than at that size. This sort of [illegible] are always supplied with from our [illegible] of five or six years growth.—But before I proceed to the taking them up, it will be proper to say, that in the planting [illegible] we divide our hands into four claſses, which we term takers-up, pruners, carriers, and planters: and here I shall describe the several methods of doing this work.

First, in taking up we have the same care to take up with good roots in the plantations, as was recommended in the nursery, though we cannot pursue the same method; but in such places, so soon as the plants are taken up, we bed them in the ground in the following manner: Dig a trench at least fifteen inches deep, and set the young trees therein with their tops aslant, covering their roots well as we go along, and almost half way up the stem of the plants, with the earth that comes out of a second trench, which we fill in the like manner, and so proceed on till we have a load, more or leſs, in a heap, as may be convenient to the place from whence they were taken. In our light soil this trouble is but little, and we always have our plants secure, both from their roots drying, and their suffering by frost. We have a low-wheeled waggon to carry them from the heaps, where they are bedded, to the pruners, and generally take two loads every other day. When they arrive, the planters, pruners, &c. all aſsist to bed them there, in the same manner as before described. We have a portable shed for the pruners to work under, which is also convenient for the rest of the work-people to take shelter under in stormy weather. From the above heaps the plants are taken only so fast as they are wanted for pruning, which work we thus perform: Cut off all the branches close to the stem, to about half the height of the plant, shortening the rest of the top to a conical form in proportion to the size of the plant; and in pruning of the roots, we only cut off the extreme parts that have been bruised by the taking up, or such as have been damaged by accident, wishing at all times to plant with as much root as can be had.

As soon as they are pruned, they are taken to the planters by the carriers, who are generally a set of boys, with some of the worst of the labourers. The planters go in pairs; one makes the holes, and the other sets and treads the plants fast, which work they commonly do by turns. In making of the holes, we always take care to throw out all the bad soil that comes from the bottom. If the planting be on the side of a hill, we lay the bad soil on the lower side of the hole, so as to form a kind of bason; for without this care our plants would lose the advantage of such rains as fall hastily. We at all times make the holes sufficiently large, which is done with great ease after our deep ploughing.

Before we set the plant, we throw a few spadefuls of the top soil into the hole, setting the plant thereon with its top rather inclining to the west; then fill up the hole with the best top soil, taking care that it closes well with the roots, leaving no part hollow. When the hole is well filled up, one of the planters treads and fastens the tree firmly with his feet, while his partner proceeds to make the next hole.

The fastening a tree well is a material article in planting; for if it once becomes loose, the continued motion which the wind occasions is sure to destroy the fibres as fast as they are produced, which must end in the destruction of the plant, if not prevented. It is to guard against this inconvenience that we take off so much of the top, as has been described in the article of pruning.

We plant about three or four hundred Birches of the large size on an acre, and nearly the same number of the first-sized Oaks. We also plant here and there a Beech, Larch, Spanish Chesnut, &c. exclusive of the patches of the said sorts of trees before planted. We then proceed to plant plentifully of the second and leſser-sized Oaks; and last of all a great number of the small Birches, which are procured from the woods at about three shillings, or three shillings and sixpence per thousand: these we remove to the succeeding plantations after the term of five or six years. Of the several sizes of the different kinds of trees, we generally plant upwards of two thousand plants upon an acre of land, all in an irregular manner.

After the planting is finished, we then sow the acorns (provided it be a season that they can be had) all over the plantation, except among the Beech, Larch, &c. in the aforesaid patches. Great care should be taken to preserve the acorns intended for this purpose, as they are very subject to sprout, especially soon after gathering: the best method is to lay them thin in a dry airy place, and give them frequent turnings. We sow these acorns in short drills of about a foot in length, which work is done very readily by two men; one with the acorns, the other with a hoe for the purpose of making the drills and covering the seed.

We are of opinion that the plants produced from these acorns will at last make the best trees; however, I will not pretend to say how that may be, as the Oaks transplanted small grow equally well for a number of years: but it is probable that a tree with its tap-root undisturbed, may, in the end, grow to a much larger size.

After the whole is finished to a convenient distance round the pruners, we then remove their shed to a second station, and there proceed in the like manner; and so on till the whole be finished.

It would be well to get the planting done by the end of February, especially for trees of the deciduous kind; but from the disappointments we meet with, occasioned by the weather, we are sometimes detained to a later season.

I have several times made trial of twelve or fourteen kinds of American Oaks sent over to his Grace in great quantities. I sowed them in the nursery, and also in the best and most sheltered parts of the plantations. In both places they come up very plentifully; but I now find that several of the sorts will not stand the severity of our winters, and those that do make so small a progreſs, as to promise no other encouragement, than to be kept as curiosities.

Towards the end of April, when the ground is moist, it will be of great service to go over the whole plantations, and fasten all such trees as are become loose since their planting. After this, nothing more will be required till the month of June, when we again go over the whole with hoes, cutting off only the tall-growing weeds; for the sooner the ground gets covered with graſs, in our light soil, so much the better.

I own there is something slovenly in the appearance of this method, and on some lands I would recommend keeping the ground clean hoed for some time at first, as also planting in rows, which in that case would be neceſsary. More than once I have tried this method on our forest-hills, and always found, after every hoeing, that the soil was taken away by the succeeding winds into the valleys.

Besides this inconvenience, the reflection of our sandy soil is so very great, that we find the plants stand a dry season much better in our present method than in the former: and whoever fancies that graſs will choke and destroy seedling Oaks, will, after a few years trial, find himself agreeably mistaken. I have even recommended the sowing the poorer parts of the hills with furze or whin-seed as soon as they are planted. We have sometimes permitted the furze to grow in the plantations by way of shelter for the game, which though it seems to choke and over grow the Oaks for some time, yet, after a few years, we commonly find the best plants in the strongest beds of whins. This shows how acceptable shelter is to the Oak whilst young; and experience shows us that the Oak would make but a slow progreſs on the forest-hills for a number of years at the first, were it not for some kind nurses; and the Birch seems to answer that purpose the best, as I have already observed.

The several sorts of Fir-trees, from appearance, seem to promise a greater shelter; but, on the forest-land, they do not grow so fast as the former; and what is worse, the Oak will not thrive under them, as they do immediately under the Birch.

Where a plantation is on a plain, a screen of Firs for its boundary is of singular use, but the situation of the forest-land denies us this advantage.

We continue to cut down the tall-growing weeds two or three times the first summer, and perhaps once the next, or second season after planting, which is all that we do in respect to cleaning. The next winter after planting, we fill up the places with fresh plants where they have miscarried, after which there is little to be done till about the fourth or fifth year; by which time the small-sized Birch, and seedling Oaks will be grown to a proper size for transplanting. In the thinning of these, due care must be had not to take too many away in one season; but being properly managed, there will be a supply of plants for at least half a dozen years to come.

About the same time that the leſser-sized Birch want thinning, the large ones will require to have their lower branches taken off, so as to keep them from injuring the Oaks; and this is the first profit of our plantations, the Birch-wood being readily bought up by the broom-makers. This pruning we continue as often as required, till the Birches are grown to a sufficient size to make rails for fencing: we then cut them down to make room for their betters.

By this time the Oaks will be grown to the height of twelve or fourteen feet, when they draw themselves up exceedingly fast. Each plant seems as it were in a state of strife with its neighbour, and in a strict sense they are so, and on no other terms than life for life; and he whose fate it is to be once over-topped, is soon after compelled to give up the contest for ever.

After the Birches are cut down, there is nothing more to be done but thinning the Oaks from time to time, as may be required, and cutting off their dead branches as frequently as may be neceſsary. We are very cautious in doing the former, knowing well, that if we can but once obtain length of timber, time will bring it into thickneſs; therefore we let them grow very close together for the first fifty years.

And here it may not be improper to observe the progreſs the Oak makes with us, by describing them in two of our plantations, the one of twenty-eight, the other of fifty years growth. In the former, they are in general, about twenty-five or twenty-six feet in height, and in girth about eighteen inches; the trees in the latter, planted in 1725, are something more than sixty feet in height, and in girth a a little above three feet; and these trees are in general about fifty feet in the bole, from which you will easily conceive the ſmallneſs of their tops, even at this age.

It would be a difficult matter to describe their farther progreſs with any degree of certainty, therefore let it suffice to make this last observation on them in their mature state.

I should have before observed, that in both the aforesaid, as well as in all the young plantations, the Spanish Chesnut keeps an equal pace, or rather out-grows the Oak, but it is doubtful whether ever they will arrive at the same size; for the largest of our Spanish Chesnuts, which have much the appearance of old trees, do not girth more than twelve or fourteen feet, which is nothing in comparison to some of our large Oaks, which girth from twenty-five to thirty feet: indeed some of them a great deal more. For instance, that remarkable tree called the Greendale Oak, (from its growing in a valley of that name near Welbeck) which, in the year 1724, had a hole cut through its body large enough to admit a coach to go through.

I shall omit describing the present state of this piece of antiquity, as two fine views of it are given in Dr. Hunter's late edition of Mr. Evelyn's Silva, from which may be seen, notwithstanding the uncommon size of the lower part of the tree, that it never has contained any great quantity of timber; I mean in comparison with several of our largest oaks, some of which contain, in their tower-like trunks, between seven and eight hundred solid feet of timber, exclusive of their stately tops; and some of their large branches are even like trees themselves.

# ESSAY IV.

## *On the comparative Utility of Oxen and Horses in Husbandry.*

ABOUT five years ago, I took some land into my occupation, and having found the expense of horses very great, I determined, somewhat more than two years ago, to make trial of oxen, and bought one pair. At that time, I am almost certain, there was not an ox worked in this county; on which account my workmen added much to the trouble of breaking them, by their obstinate prejudices against the use of them.

At last I was fortunate enough to select a labourer, who, though totally unused to them, was willing to take proper pains to break them. By his good treatment and temper, they soon became tractable, and as handy both at ploughing and carting as any horses.

Being well satisfied with their performance, I resolved to dispose of all my draft horses, and substitue oxen in their stead. I have now completed my plan, and have not a single cart-horse; but the work of my farm (which consists of upwards of one hundred acres of arable land, and sixty of pasture and wood) is performed with ease by six oxen; together with my statute-duty on the high-ways, ploughing, carting, harrowing, rolling, and every part of rural buſineſs.—They are shoed constantly: their harneſs is exactly the same as that of horses, (excepting the neceſsary alterations for difference of size and shape) they are drove with bridles, and bits in their mouths, and answer to the same words of the ploughman or carter as horses, and as readily. A single man man holds the plough, and drives a pair of oxen with reins; they will regularly plough an acre of land, every day, and in leſs than eight hours time; I believe they will do it in seven; but I would not aſsert more than I know they perform.

I have a small plantation, in which the trees are planted in rows ten feet asunder; the intervals are ploughed by a single ox with a light plough, and he is driven by the man who holds it. I mention this as an instance of their great docility.

My oxen go in a cart single, or one, two, three, or more in proportion to the load. Four oxen will draw eighty bushels of barley, or oats, in a waggon, with ease; and if they are good in their kind, will travel as fast as horses with the same load.

I frequently send out eighty bushels of oats with only three oxen; and forty bushels with one ox, in a light cart, which I think of all others the best method of carriage. My workmen are now perfectly reconciled to the use of oxen; and the following reasons determine me to prefer them greatly to horses:

*1st.* They are kept at much expense.—Mine never eat corn or meal of any sort. During the winter, they are kept in good order for work upon straw, with turnips, carrots, or cabbages; for want of either of the three latter, I allow one peck of bran a day to each ox, whilst in constant work. When my straw is finished, and the spring advances, they eat hay; and if they work harder than common in the seed time, they have bran beside. When the vetches are fit to mow and give them in the stable, they have nothing else. After the day's work in the summer, they have a small bundle of hay to eat, and stand in the stable till they are cool, and are then turned into the pasture.

I am of opinion, that the annual difference of expense in keeping a horse and an ox, each in condition for the same constant work, is at least four pounds.

*2dly.* The value of a horse declines every year after he is seven years old; and is scarcely any thing if he is blind, incurably lame, or very old. But if an ox is in any of those situations, he may be fatted, and sold for much more than the first purchase; and will always fat sooner after work than before.

*3dly.* They are not so liable to illneſs as horses. I have never had one indisposed.

*4thly.* Horses (especially those belonging to gentlemen) are frequently rode by servants without their master's knowledge, and often injured by it. Oxen are in no danger of this kind.

*5thly.* A general use of oxen would make beef, and consequently all other meat, more plentiful, which I think would be a national benefit.

That it may not be thought, that a pair of oxen will plough an acre of land in a day only upon a very light soil, I must add, that the greater part of my arable land is too heavy to grow turnips to advantage. When my lighter lands are in fine tilth, I make use of a double plough; a single man holds it, and drives one pair of oxen, and will plough two acres a day.

I am well aware that the method of working oxen with a yoke spares a considerable expense in the article of harneſs; but they move so much more freely with collars, and can be used with so much more advantage singly by the latter method, that I think it far preferable.

After experience has inclined me to give the preference to oxen, I will not omit in my account the only material inconvenience I have found in working them: which is, they are troublesome in shoeing, at least I have found them so in this country; and, I believe, chiefly because my smith never shoed any before. I have them confined in a pound whilst they are shoed, and a man attends the smith. However, I think this disadvantage amply recompensed by more material advantages; and can with great truth affirm, that the longer I have worked oxen, the better I have been satisfied with them.

## ESSAY V.

### *On breaking up of Graſs Land, together with some Practical Observations.*

When it is determined on to convert Graſs Land into Tillage, I would recommend the land to be ploughed out in the Spring, and instead of the customary method of performing the work with one plough, I consider it as a more judicious practice to introduce two ploughs, the first for turning the turf to the depth of two inches; and the other for covering it, by working in the same direction. By this method, a greater quantity of loose mould will be raised, which, besides other advantages, will occasion a considerable saving in seed. No land whatever requires so much seed as sward on a single ploughing; because from the solid nature of the furrow, much of the seed is exposed to the ravages of birds, and consequently is lost to the cultivator. In a general way, oats are sown for a first crop pretty early in spring; but I see no impropriety in making wheat or maslin the first crop; in which case the land must have another ploughing in the autumn. The next crop should be oats. By these two crops a large quantity of manure will be produced against the third year, when the land should be summer fallowed, let its quality be ever so good. The land thus fallowed should have a good dreſsing of lime and dung bestowed upon it, and at a proper season, should be sown with turnip-seed, to be eaten off with sheep. On the turnips being eaten off, the land should be sown with barley and graſs-seeds, or with seeds alone; and as by this disposition the soil is made to retain all its original richneſs, the cultivator will be sure to see his land much improved. To keep the land longer under the plough, would produce more profit to the occupier; but as I am contending for the laying down land in a judicious manner, I can by no means recommend a longer continuance of the plough.

About eight years ago, I broke up some acres of graſs-land of a quality rather too strong for turnips. It had been laid down without any manure by a former tenant, about twenty years before. The land being thin skinned, I was induced not to pare and burn it. The first year it was sown with oats, and produced stronger quality, the sward is usually ploughed out and sown with oats. The second year it is spring-fallowed, and sown with rape, to be fed off with sheep, after which it is sown with wheat in autumn. The following year they take a crop of oats, and then spring fallow, and sow with rape and seeds; a practice that is experimentally found to improve their lands. Within the township of Drax, in the West-Riding of Yorkshire, the land, when in graſs, is much disposed to produce daisies. It is between a clay and a sand, upon a spongy bottom. There the land when ploughed out of swarth is sown with line, and carefully weeded. When the crop is drawn, the land is ploughed to the depth of three inches, after which it is well covered with dung, procured from York or Hull. It is then sown with wheat. The following year it is sown with Tartarian oats. These are succeeded by rape and seeds. By continuing this system for three or four years, the land is made to change its nature, but it soon after begins to show a disposition to return to its natural state. After remaining a few years in graſs, the land is again sown with line, and the former course uniformly attended to. In confirmation of the good effects of this practice, I shall beg leave to relate an experiment conducted by Hewlay Baines, Esq. of Bell-Hall, in the East-Riding of Yorkshire. About five years ago, he broke up five acres of old sward, with a view to level the ground. The soil of a sandy nature. The first year of breaking up the sward, it was sown with line-seed, which was sold upon the ground for nine pounds per acre. After the line was drawn, the land was ploughed three times and sown with maslin at the usual season. The crop, four quarters per acre; after which the land was ploughed. The following spring it was croſsed, harrowed, ploughed, and made fine. It was then dunged over and had two chaldrons of lime spread upon each acre, after which the whole was sown with seeds. Before Michaelmas, the seeds were fully ancle deep, and were eat off with sheep. This land has now been pastured two years, and has maintained more stock than any land of the same extent within many miles of it. Mr. Baines has taken up another field, and cultivated it in the same manner. It was sown with seeds this year, which came up so well, as to appear at a distance like a field of rape. Had this field been sown with rape, along with the seeds, it would have been more profitable, and without the least injury to the seeds. This plan is certainly a good one; but I do not think that a poor farmer could execute it without some variation, in order to make it more profitable. The plan of management where I live, and upon some of Lord Egremont's farms at Catton and Wilberforce, is as follows—After a crop of oats they sow turnips with dung and lime, then oats or maslin, next oats or barley, with seeds. By this rotation of crops, the lands have within these twenty years been much improved. I have at present some land under seeds, one part of which had dung only, and the other dung and lime. The difference in favour of the lime and dung, is discernible to a hand-breadth. This practical information is worthy of notice. Lord Carrington's tenants at Kirby-Underdale, Painstrop, and Hang-Grimston, have laid down a judicious plan of cultivation for their situation. The lands mostly lie in a cold and elevated situation, where wheat seldom ripens or comes to perfection, owing to the mists hanging too long upon the hills in the mornings. The soil is mostly upon a white chalk, but being of a bad quality, it will not answer the expense of bringing coals at a distance to burn it. When these sheep-pastures were first broke up, they were pared and burnt, and sown with turnips. Oats followed the turnips, then turnips again. After that oats, then rape and seeds. It may here be observed, that two white crops never succeed each other. These lands when first broken up, produced nothing but moſs, bent, and long white graſs, and but poorly maintained two Wolds sheep per acre, but now they are capable of maintaining four sheep per acre, with a portion of other cattle. From this it is evident, that a quick rotation of crops that are not of a distreſsing nature, with a speedy return to the original clothing of graſs, is the wisest and surest plan of improvement that can be desired, and will fully answer in all soils and situations. The following experiment is worthy of record. A person desirous of returning into graſs a portion of cold clay land, that had been near eighty years in tillage, prepared the same by a summer and winter fallow. In the spring, the land was sown with barley and seeds, but these made but a poor appearance after the barley was reaped. It is remarked, that the winter frosts always lighten clay lands more than any other kind, and also that the spring rains wash the light greasy parts of the soil from the roots of the seeds. In consequence, some are left rootleſs, and those that have the good fortune not to be undermined, only grow in tufts; the surface of the ground appearing bold in summer. This happened to be the case here; so that the land was ploughed out after the first year, and sown with beans. It was then spring-fallowed, and again sown with barley and seeds. Though the seeds turned out better than formerly, they were not near so good as they ought to have been. After two years, the land was ploughed out, and again sown with beans, after which it was sown a third time with barley and seeds. These fully answered expectation; and the land is now a fine piece of clean swarth, to which every change seems to have added new life.

I should have observed, that eight loads of manure was laid upon each acre. Lime was little used in this township when this land was laid down.

This experiment clearly shows the danger of keeping land too long under the plough, if ever intended to be brought to swarth. Weak, sandy, and moor-land ought never to go beyond three or four crops. 1st, Turnips, after paring and burning: 2d, Oats or rye: 3d, Turnips, or rape with seeds, or oats with seeds, after turnips. This course is practised with succeſs about Haxby, Wigginton, Sutton upon the Forest, and many other places similarly circumstanced. The rich sandy lands about Greenhammerton, Whixley, and Borroughbridge, are cropped differently, and are kept much longer under the plough. There the course is: 1st, Wheat or oats upon swarth: 2d, Another crop of oats, or wheat to croſs the first crop, if in oats: 3d, Turnips: 4th, Barley, with clover: 5th, Wheat. Some of the farmers keep in this course for many years, without seemingly impairing the strength of the land; but I know of no land that will go the same length that these lands do. Strong lands are the most stubborn and critical to manage, and should only go short courses; for the longer they are kept under the plough, the stronger they grow, and consequently the difficulty is increased in bringing them to graſs. In general, the first crop hardly repays the labour.

Some prejudice still remains respecting paring and burning. The opposers of this practice say, that it destroys the soil; but I am not disposed to admit that it destroys one particle of it, beyond what is carried off in smoke, and that we know is restored again to the earth, though it may fall upon another man's land, mixed with the rain and dews of heaven. What misleads the opposers of this practice is, that they do not see the ashes lie in such large heaps after burning as before; forgetting the false package of the sods, which are composed of rushes, &c. with very little soil; and which, by fire, must certainly be reduced into a smaller compaſs. I and my father have repeated this operation twice upon the same land within fourteen years. In 1799, I pared and burnt ten acres that had been burnt thirteen years before. The field was sown with turnips, and the second year with oats. It is now sown with maslin, and looks wonderfully well. I have often remarked, that by paring and burning, strong land may be made to produce a good crop of turnips; and upon that kind of land the crop stands the winter better than on what is called turnip-land. In 1796, I pared and burnt some sharp pry-graſs Ings that had not been ploughed in the memory of man. The first crop was turnips, that were eaten off with sheep about Lady-day. It twice bore a crop of turnips, and last year it was fallowed and well limed, and this year it is in wheat, which looks well. In the spring I propose to sow graſs-seeds over the wheat; a practice that I have often seen followed on land of a similar kind. I have taken up another field of ings-land, and of the same quality, and after paring and burning, have sown it with rape. After bearing one, or perhaps two crops of oats, I propose to fallow it with lime, all my dung being required for turnips. I shall then crop it with wheat and graſs-seeds, as before mentioned. This course is proper for strong land, but where the soil is poor, and lime cannot be had, it is good husbandry to have one green and one white crop alternately for four or six years, according to the plan laid down by Lord Carrington for his tenants on the Yorkshire wolds. The depth that land should be ploughed at, on its being first broken up, is undetermined. It must depend on the quality of the land. It is well ascertained that the sward, on its being first broken up, should not be ploughed very deep, because it is observed, that the corn does not thrive well when it has taken hold of the sole, or floor of the land. However, good land ought, and may at any time, be ploughed deeper than what is poor. I should think five inches deep enough for the best land, and three or four inches for the worst. The lands that may be ploughed the deepest, are, rich sands, deep loams, good gravel, and warp. Those that should be ploughed the lightest, are, thin clays, thin chequery soils, and weak sands with a spongy bottom. In a former part of this Eſsay I have mentioned the crop with which seeds ought to be sown. The best method is certainly to sow them with rape. Sometimes they are sown alone, though most commonly with oats or barley after a crop of turnips. My experience decides in favour of rape. From the late sowing of buck-wheat, and its open bottom, it is probable that it may become a good nurse for hay-seeds; but of that I have had no experience. Farmers in general observe, that the quantity of hay-seeds to be sown, can never be too great. Different soils require different quantities. Strong lands require a greater quantity than lands of a gentle nature. Fourteen or sixteen pounds of the small seeds, with a bushel of rye-graſs, or a quarter of hay-seeds, is sufficient for lands of the kindest quality; but people who purchase hay-seeds of an inferior quality, can never tell when there is a sufficient quantity. Lands of a strong quality will require eighteen or twenty pounds of small seeds, with ten bushels of hay-seeds, or five pecks of rye-graſs, per acre. Rye-graſs is proper, where land is only to continue two years in graſs; but lands that are intended to remain longer, should be laid down with hay-seeds. A particular attention should be paid to the quality of the hay-seeds, as those procured from post-masters and ostlers, generally contain the seeds of pernicious weeds. It is therefore the best husbandry for the farmer to grow his own hay-seeds, which he may do with great ease, by alloting a few acres of meadow for that purpose; in which case he should employ women and children to pick out the docks and other weeds before the swarth is turned; for the graſs being very ripe, there is danger of the weeds shaking their seeds during the time that the graſs is making into hay. It is undetermined among farmers, whether the seeds should be mown the first year, or fed upon the ground. I am decidedly of opinion that they should be fed upon the land, as the treading of the sheep and cattle, will render the ground firmer, and consequently enable the roots of the new-sown graſs to take a better hold. Besides, the dung of the sheep and other cattle, will add vigour to the maiden graſses, and preserve them during the winter. I even prefer the lands to be pastured the two first years, after which there can be no doubt of their forming a good meadow. Some farmers, however, are of opinion, that it is the best husbandry to mow the seeds the first year, and after that to manure them plentifully before winter. I once mowed a field of seeds the first year, but not having any dung to spare from my turnips, I had the mortification to see the land become quite white, and to continue so throughout the whole winter, and during the greatest part of the following summer; and indeed the land never looked well afterwards; so I was obliged to plough it up. Nothing but having a good coat of dung ready for the land before winter, can justify its being mown the first year of its bearing seeds; but that is not often the case with those farmers who live remote from a large town, from whence dung may be procured of a superior quality to what they can make at home. And here I beg leave to caution both landlords and tenants, against breaking up too much of their old grazing land that happens to be of a strong quality. For though such land will produce abundance of corn, without the fear of being exhausted; yet there sometimes will be danger when we come to the seed-year, lest the corn should lodge in consequence of the natural richneſs of the soil, whereby the seeds will be choaked in their infancy. A long continuance of rain, and thunder-storms, will accelerate the lodgment on such lands, as are poſseſsed of much vigour; so that a considerable degree of discretion will be required in this particular. The safest and best way would be, to lay down such land with rape and hay seeds, or with seeds alone, as mentioned in a former part of this Eſsay. To conclude, experience and observation justify a short rotation of crops, with a ready return to graſs, before the land begins to show a decrease of vigour. By a proper attention to this, the worst land may be improved, the middling sort enriched, and the best land left in poſseſsion of all its natural vigour.

## ESSAY VI.

### *On the Turnip Husbandry.*

In cultivating Turnips to advantage, great care should be taken to procure good, bright, nimble, and well-dried seed, and of the best kind.

The Norfolk farmers generally raise the oval white, the large green-topped, and the red or purple-topped kinds; which from long experience they have found to be the most profitable.

The roots of the green-topped will grow to a large size, and continue good much longer than others. The red or purple-topped will also grow large, and continue good to the beginning of February; but the roots become hard and stringy sooner than the former.

The green-topped growing more above ground, is in more danger of sustaining injury from severe frost than the red or purple, which are more than half covered by the soil, but it is the softest and sweetest when grown large, of any kind. I have seen them brought to table a foot in diameter, and equally good as garden turnips.

Turnips delight in a light soil, consisting of sand and loam mixed; for when the soil is rich and heavy, although the crop may be as great in weight, they will be rank, and run to flower earlier in spring.

Turnip-seed, like that of grain, will not do well without frequent changing. Our Norfolk seed is sent to most parts of the kingdom, and even to Ireland; but after two years it degenerates; so that those who wish to have turnips in perfection should procure it fresh every year from Norwich, and they will find their account in so doing. From its known reputation, many of the London seeds-men sell, under that character, seed raised in the vicinity of the metropolis, which is much inferior in quality.

The only risk in sowing turnips, is the danger of their being eaten by the fly, especially in a dry season. This is an evil for which art has not yet found a certain and effectual remedy; showers, as soon as the plants appear above ground, are the best preservatives. They hasten the plants into rough leaf, in which state they are out of danger.

When the plants have got five leaves, they should be hoed, and set out at least six inches apart. A month afterwards, or earlier if it be a wet season, a second hoeing should take place, and the plants be left at least fourteen inches distant from each other; especially if intended for feeding cattle: for where the plants are left thicker, they will be proportionably smaller, unleſs the land is very rich indeed.

Some of our best farmers sow turnips in drills, three feet asunder, and at a second hoeing leave them a foot apart in the rows. By this means the trouble and expense of hoeing is much leſsened, and the crop of equal weight, as when sown in the common method. The intervals may easily be cleared of weeds by the horse-hoe.

Great quantities of turnips are raised with us every year for feeding black cattle, which turn to great advantage.

It is well known, that an acre of land contains 4840 square yards, or 43560 square feet; suppose then that every square foot contains one turnip, and that they weigh only two pounds each on an average, here will be a maſs of food, excellent in kind, of forty-six tons per acre, often worth from four to five guineas, and sometimes more.

Extraordinary crops of barley frequently succeed turnips, especially when fed off the land. In feeding them off, the cattle should not be suffered to run over too much of the ground at once, for in that case they will tread down and spoil twice as many as they eat. We generally confine them by hurdles to as much ground as is sufficient for them in one day. By this mode the crop is eaten clean, the soil is equally trodden, which, if light, is of much service, and equally manured by the cattle.

A notion prevails in many places, that mutton fattened with turnips is thereby rendered rank and ill-tasted; but this is a vulgar error. I know that the best mutton in Norfolk is all fed with turnips. It is rank pasture, and marshy land, that produces rank mutton.

If the land be wet and springy, the best method is to draw and carry off your turnips to some dry pasture; for the treading of the cattle will not only injure the crop, but render the land so stiff, that you must be at an additional expense in ploughing.

# ESSAY VII.

## *The natural History of the Cock-Chaffer.*

THERE are few insects more prejudicial to the farmer than that generally known by the name of the *Cock-Chaffer*. In different parts of this kingdom these insects are called by different names, such as the *Chaffer*, the *Cock-Chaffer*, the *Jeffry-Cock*, the *May-bug*, and (in Norfolk) the *Dor*.

In what claſs Linnæus ranks them, I do not remember; but they seem to be the *Scarabeus arboreus vulgaris major* of Ray.

When full grown in their grub state, they are near an inch and a half long, and as big as a child's little finger. Their heads are red, their bodies soft, white, and shining, with a few hairs on the back. They have three hairy legs on each side, all placed near the head, in which are two forceps, or jaws, like the hornet; with these they cut asunder the roots of graſs, corn, &c. and frequently destroy whole fields in a short time. In this *eruca*, or grub state, they continue three and sometimes four years.

In their beetle state they have two pair of wings; the one filmy, and the other scaly. The *interior* pair are folded up in a curious manner, and remain hid, unleſs when expanded for flight. The *elytra*, or case-wings, are of a reddish brown colour, and sprinkled over with a fine white powder, like the auricula. The legs and tail (which is pointed) are whitish. The body is brown, except at each joint on the sides of the belly, which is indented with white. The circles round the eyes are yellowish; the antennæ short, and terminated by fine lamellated spreading tufts, which the creature expands more or leſs as it is brisk and lively, or otherwise.

The first account I find of these destructive insects, is given by Mouffett, who tells us, that in the year 1574, such a multitude of them fell into the Severn, that they clogged, and even stopped, the wheels of the water-mills.

There is also an account in the Transactions of the Dublin Society, that the country people suffered so much in one county, by the devastation these insects made, that they set fire to a wood several miles in length, to prevent their further progreſs.

In the day-time they seldom fly about, but conceal themselves beneath the leaves of oak, sycamore, maple, hazel, lime, and some other trees, which they soon eat to a skeleton; but about sun-set they are all on the wing, and fly about the trees and hedges as thick as a swarm of bees.

While in their grub ſtate, they entirely destroy all the graſs, corn, or turnips, where they harbour.

I have seen fine meadows withered in May and June, and as brown as thatch.

The grubs generally lie near two inches below the surface, and eat the roots of the graſs so regularly, that I have rolled up many yards of the withered turf as easy as though it had been cut for a garden.

When they attack turnips, they eat only

the middle of the small root; but by that means kill all they bite without remedy.

Neither the severest frosts in our climate, nor even keeping them in water, will kill them. I have kept some in water near a week; they appeared motionleſs; but on exposing them to the sun and air a few hours, they recovered, and were as lively as ever. Hence, it is evident, they can live without air. On examining them with a microscope, I could never discover any organs for respiration, or perceive any pulsation.

Hogs will root up the land for them, and at first eat them greedily, but seldom meddle with them a second time. To rooks and crows they seem to be a high regale. When numerous, they are not destroyed without great difficulty; the best method is, to plough up the land in thin furrows, and employ children to pick them up in baskets: and then strew salt and quick-lime, and harrow in.

About thirty years since, I remember many farmers' crops in Norfolk were almost ruined by them in their grub state; and in the next season, when they took wing, the trees and hedge-rows in many parishes were stript bare of their leaves as in winter. At first the people used to brush them down with poles, and then sweep them up and burn them. One farmer made oath, that he gathered eighty bushels; but their number seemed not much leſsened, except just in his own fields.

Their mode of *coupling* is singular; and the time of their continuance in that act, sometimes two or three days. I have seen one of them fly in that state, with the other hanging pendant from its tail; and am in some doubt whether (like snails) they are not *hermaphrodites*, as there seems to be mutual insertion.

They deposit their eggs in the earth. The first year the grubs are very small, and do little mischief; the second year they are increased to the size of a goose-quill, and are very injurious to the herbage; the third year they attain their full size, and fly.

# ESSAY VIII.

## *On the ſucceſsful Introduction of new Articles into Field Culture.*

If in the idea of new articles be included those which have been transferred from the garden to the field, the number will be far from being inconsiderable. Turnips, potatoes, cabbage of different kinds, carrots, parsnips, &c. were cultivated for domestic uses, long before the time proposed; but the field culture of these articles for the feed of cattle, in any considerable degree, is quite a modern practice. The succeſs which has attended the use of these articles, hath incontestibly established their great value and importance; but unfortunately their culture hath been hitherto much confined, and is very far from being generally practised.

Many kinds of graſses have likewise been strongly recommended as valuable improvements, which, having answered the sinister views of some of the recommenders, in selling their seeds at a great price, and upon trial being found greatly inferior to the spontaneous growths of this country, have very deservedly fallen into general disuse, and are no more thought of. There are two articles, however, commonly reckoned among the graſses, which must ever be distinguished and separated from those that have been found uſeleſs, that is to say, Sainfoin and Lucerne; these merit more attention and care than have been usually bestowed upon them, and would well repay the farmer for all his expense and trouble, if bestowed with discretion and judgment, for they certainly might be made improvements of the most valuable kind.

Sainfoin has been sown pretty extensively in some parts, but not so generally by far as it deserves. It generally succeeds well upon chalk, from whence it has been very erroneously concluded, that it will not thrive in a deep soil. It is supposed a hard substratum of chalk prevents the deep penetration of the roots, which is the natural bias of the plant, for it is not known to what depth it would descend in a friable soil that would yield to the perpendicular descent of its root. From hence it is strangely concluded, that the plant in such soil is exhausted of its vigour by the luxuriance of its own roots; and that the produce of the herbage on the surface is small in proportion as that of the roots is large. This notion, repugnant as it certainly is to common sense and reason, as well as to experience and observation, is firmly believed and maintained by men of very good abilities; so invincible are prejudices early imbibed, and supported by local customs, and habits of practice long established.

I am clearly of opinion, that there are few arable farms in the kingdom which are not capable of great improventment by planting of sainfoin, more especially those which are but poorly provided with good pasture and meadow land. The poorest fields of such farms might, by proper management, be brought to produce good crops of sainfoin; and land, the natural intrinsic value of which is not more than from 2s. 6d. to 5s. an acre per annum, might certainly, at a very moderate expense, be made worth from 20s. to 40s. This would prove an unspeakable advantage to the occupier as well as to the owner of a farm that is almost wholly arable, as it would enable him to keep a much larger number of milch-cows, and hogs in proportion, and by these means greatly increase the quantity of manure for the improvement of his corn-fields.

The greatest enemies sainfoin has to encounter, are graſs and weeds: these in land that is tolerably good, soon overcome and destroy it, unleſs the farmer will take the trouble, and be at the expense of keeping it clean. But this is by no means so formidable an undertaking as hath been generally thought, provided the land be very well cleaned and duly pulverized before the seed be sown; and provided also it be sown in rows from fifteen to eighteen inches distant, which is as near as it ought to be sown, if intended for a lasting plantation. At those distances, the intervals between the rows may be kept perfectly clean with a small plough and a narrow drag of about twelve inches wide. With these instruments several acres may be cleaned in a day, and supposing this to be done three times in a summer, the expense would amount but to a trifle. My drag is twelve inches wide, and proves extremely useful in drilled crops of every kind, as also in those of what nature never fear are planted in rows.

Lucerne, under a similar management, would be a very great improvement on arable farms. Indeed an opinion generally prevails, that it requires a much better soil than is commonly found. Crops of all kinds are more abundant on a good than on a bad soil, if they are kept clean; but it is a very erroneous opinion, that lucerne will thrive only on rich land. It may be raised to great advantage on land of a very indifferent quality, by the same means as above recommended for sainfoin, and the same care to keep it free from graſs and weeds. I have cut five good crops off such land in one summer, after having been planted five years, without a grain of manure of any kind, except a small sprinkling of turf ashes the second year after sowing the seed. A few acres of either, or both these graſses, with a few more of potatoes, cabbage, or turnips, would enable the occupier of an arable farm to keep from eight to twelve, or even twenty milch-cows, according to the size of his farm, though he should not have an acre of meadow or pasture belonging to the same.

Of articles which are truly useful and entirely new, we know of few that have been introduced within the time mentioned. The turnip-rooted cabbage is a truly valuable root, which was accidentally discovered about twenty years ago, and has been cultivated with great ſucceſs by several gentlemen, and strongly recommended by them to the attention of the farmer. Both its roots and greens are exceeding good food for cattle, but what constitutes its principal excellence is its extreme hardineſs, for it resists the violence of the most rigorous seasons and severest frosts. When the common turnip and hardiest cabbage have been entirely cut off and destroyed, this has continued its fine verdure, and supplied the kitchen with greens, and the cattle with sweet and wholesome roots, even till the middle of May.

Another new article which has been very lately introduced, is the *Mangel Wurzel*, or Scarcity Plant. From the ſucceſs some few gentlemen have had in its cultivation, it seems to promise to be of the greatest utility for the feed of cattle. However, it is very little known as yet, it being supposed that not one farmer of a thousand has so much as ever heard of the name. It is generally agreed to be a species of the beet, of which there are many. The seeds of both have exactly the same appearance, and the leaves and roots differ only in colour and size, for the manner of their growth is exactly the same; but the leafage of the new sort is said to be much more luxuriant and abundant, and the roots vastly larger.

In order to discover the most advantageous mode of raising this plant, I sowed, or rather set, a quantity of the seed in several different ways in April last. The beginning of July, the outside leaves had obtained their full growth, some of which I broke off and offered to the horses and cows, who ate them very freely; but when offered to the pigs, they seized them with great eagerneſs, and devoured rather than eat them. The pigs are still fed with them daily, and constantly prefer them to every kind of green food or root that can be given them. Breaking off the leaves takes up much time, and is very troublesome; therefore when the outside leaves are fully come to maturity, I cut the whole clean off about an inch and a half above the ground, from whence fresh leaves shoot up very freely.

My experience is yet too small to speak with confidence; but it seems to me, an acre of this plant, if it takes well, would be sufficient to keep twenty pigs very well for five or six months, say from July to November, or December, inclusive.

The improvements made by cultivating turnips for the feed of sheep and fattening of cattle, is so generally known, and extensively practised, that it seems unnecefsary to say any thing on that head. I will, however, beg leave to observe here, that the opinion generally maintained, that turnips are an improper food for milch-cows, as it spoils the cream and butter by impregnating the milk with the strong flavour of the turnip, appears to me, by repeated experiments, to be ill-founded. The two last winters and springs my milch-cows lived chiefly on turnips, and their butter was found not only as good as my neighbours, whose cows ate none, but was even preferred to it. They say their opinion is grounded on experience as well as mine. The difficulty, I apprehend, lies here: My turnips are pulled, brought home, and given to the cows in the yard; their cows have been used to be turned in upon them, where they pick up the charlock and other weeds which abound among them, for they are never hoed; and to this, and not the turnips, I am persuaded, the disagreeable flavour of the milk is owing. It must be observed that the turnips should be given to the cows while they are fresh and firm, for all food when grown putrid and corrupted is unwholesome, and doubtleſs would affect the juices of the animals that eat it.

Of all the articles we have mentioned, or that is yet known, perhaps very few can equal, and none excel the *Potatoe.* The inestimable value of this root is hardly to be conceived. It is not only an almost constant dish in great and opulent families, but in times of scarcity and dearneſs, the poor are almost wholly subsisted by it. There are many poor families in this neighbourhood, who, the last winter, ate them three times a day with a little salt, without a morsel of meat or bread with them. It is true they have been long in use for the food of man, but it is of late date that they have been extensively cultivated for the feed of cattle; and even now I am pretty clearly of opinion, that if they were much more generally cultivated than they have hitherto been, the farmer would find his account in it, especially where a substitute is much wanted in the winter and spring seasons for the support of his cattle.

Hogs are immoderately fond of potatoes, and will live entirely upon them them till they are fit to put up a fattening for pork or bacon; and then, boiled and mixed with barley or pease meal, they fat them speedily and make fine meat. Another use I have put them to, which has been little practised, or thought of; that is, for the feed of milch-cows. Three gallons a day, half at night, and half in the morning, is quite sufficient to keep a large cow in full milk, and the milk as sweet and as good as in the summer months. Nothing excels them for the feed of cows which are fatting their calves for the butcher. I fatted four last spring, which were sold for from 35s. to above 40s. a calf, which was double what I ever sold any for at this place before. Last year, after taking them up, several calves, about six or seven months old, were turned into the potatoe ground with the cows; they fed upon them as kindly as so many pigs, and preferred them to every thing else they could meet with.

I have had no experience of their use as food for horses; but I have been aſsured by a gentleman who resided some years in Ireland, that he kept his hunter, a stone horse, entirely upon them instead of corn. He ate nothing else, excepting hay between his feeds of potatoes, as other horses; yet he was as fat, as healthy, and nearly as strong, and as full of spirits, as if he had given him all the corn he could eat.

## ESSAY IX.

### *On the Generation of Plants.*

TO illustrate the generation of plants, we must take our first lights from the animal kingdom, and pursue the chain of nature till it leads us to vegetables. If we consult physiologists, who have undertaken to illustrate the animal functions, we shall find them perfectly in the dark in every thing relating to generation. The followers of Harvey teach us, that the rudiments of the future fœtus exist in the egg of the mother, and that the prolific fluid of the father excites the first motion of the vital speck in the embryo, by means of an exhalation, a spirit, or according to some recent philosophers, by an electrical power. The disciples of Lewenhoek, on the contrary, aſsert, that in the speck of life in the yolk is a cavity, and that one of the worms which are floating in the fluid furnished by the male, insinuating itself into this cavity, is there transformed into an embryo. I am afraid both parties are mistaken, but it is not for me to decide on so difficult a point. Certainly, however, the opinion of Lewenhoek has always to me appeared very paradoxical. I have seen in the male sperm those bodies which he calls worms, and am perfectly convinced that they occasion the fecundation of the egg; but I can by no means conclude that these are living worms, or organised bodies endued with life. To say how this great work is performed, I leave to those whose busineſs it is to treat of it; and, if I have not been so fortunate as to see the whole truth, must be content with having discovered traces of it. I shall take some examples from the production of mule animals, which may throw light on this very obscure subject. For instance, we see in the horse kind two different mules produced. From the mare and the male aſs proceeds the mule properly so called, which in its nature, that is, in its medullary substance and nervous system, agrees with its mother; but in its cortical substance and outward form, in its mane and tail, resembles the aſs. Between the female aſs and the horse, the other kind of mule is engendered, whose nature, or medullary substance, resembles that of the aſs, but its cortical structure that of the horse.

Daily experience likewise shows us, that if the he-goat of Angora (Tournefort's Voyage, 185) copulates with the common she-goat, the kid by that means procured, inherits the external structure and valuable coat of its father, so much used in various manufactures; while on the contrary, if the common he-goat impregnates the she-goat of Angora, the kid produced has the same external form, and bears the same worthleſs hair, as its father.

Hence it seems probable to me, that the medullary substance, with what Malpighi calls the keel (*carina*) and the nervous system, are latent in the egg of the mother, the cortical substance, or vascular system, being derived from the father; but to discover more clearly the mode in which these substances are combined, requires a much deeper investigation. However this may be, we learn from observation and experience, that in all the known species of animals, generation is absolutely neceſsary, and that no egg becomes prolific, unleſs it be first fecundated by the male sperm.

Animals are by the lower tribes of *Zoophyta*, brought so near to vegetables, that, as I have before observed, we in some cases scarcely know how to distinguish the one from the other. Plants, however, are neither furnished with a stomach, nor an intestinal tube, as they digest nothing, but only extract chyle from the moist earth by means of their roots, which are analogous to the lacteal veſsels of animals; at the same time it must be confeſsed, that it would be extremely difficult to demonstrate this intestinal tube in the *Sertulariæ*, and the smaller Polypi. Vegetables are also destitute of a heart, nor have they any occasion for one, as the warmth of summer expands their fluids, and by this means they are extended at their summits, where there is the least resistance; but neither can any heart be discovered in the animals which we have just mentioned.

We see insects undergo a transformation, and when it is accomplished, they become fit for the work of generation. But these animals when transformed, butterflies for instance, are not more unlike the caterpillars from whence they spring, than flowers are to the herbs which bear them.

The silk-worm, after transformation, is entirely destitute of a mouth, its sole occupation being to propagate its species, that is to copulate and to lay eggs. In the same manner, all plants undergo a transformation; they proceed from the herb, in which they had remained concealed, like the silk-worm in its caterpillar state, and exhibit their true form naked in the flower, whose only buſineſs likewise is to propagate its species. The evolution of flowers is exactly similar to the exit of insects from their caterpillars; the bark bursts, and is changed into a *calyx*, becoming the external covering of the flower, and the guardian of the young fruit; while the more delicate and pellucid inner bark is farther extended into the beautifully coloured *corolla*, which vibrates to every gale that blows, like the wings of a butterfly, receiving that motion from the surrounding atmosphere, which it is incapable of spontaneously giving itself. But the most important parts of the flower, and which are abſolutely eſſential to it, are the *stamina* and *pistilla*. So eſſential are they, that among the many thouſands of flowers with which we are acquainted, no one can be found not furniſhed with both theſe organs. The stamina derive their origin from the ſubſtance of the wood, which was originally formed from the inner bark, and they may therefore be ſaid to ſpring from the cortical ſubſtance of the vegetable. This is perfectly evident in the *Asarum* (Asarabacca) whoſe twelve stamina proceed from twelve fibres in the inner bark. Double flowers illustrate the ſame fact: in them, the stamina being weakened and diſſolved by exceſs of nouriſhment, the woody ſubſtance reaſſumes the ſoftneſs of the inner bark, of which it was originally formed. All stamina conſiſt of veſſels containing the *pollen*, or impregnating powder, which they diſcharge in due time, not without the ſtricteſt obſervance of certain natural laws. The form of theſe veſſels, like that of the capſules of the fruit, is accurately defined, as well as their cells, their particular manner of burſting, and the *pollen* which they contain; this *pollen*, likewiſe, is no leſs certain and uniform in its figure, ſize, and colour, than the ſeeds themſelves.

The *pistillum* is the only part which originates from the medullary substance, and is therefore invariably situated in the centre of the flower. It always contains the rudiments of the seed, which, in proceſs of time, ripen into fruit. The rudiments of the fruit are called the *germen*, or seed-bud; this has constantly another organ connected with it, named the *stigma*, which is in its highest degree of vigour and perfection during the time of flowering.

Another circumstance worthy of attention is, that the root, which the first year of its growth is large, and filled with medullary pulp, the following season becomes hollow, in producing the stem, flowers, and seed; all this pulp being conveyed to the flower, and seeming to be only destined to the formation of seed, so many new and distinct animations being formed from it, as there are rudiments of new plants. This is particularly observable in the turnip.

Thus vegetables, like insects, are subject to a metamorphosis; with this difference only, that their flowers are fixed to one spot, instead of being able, like insects, to fly from place to place; and that their nourishment is not given them by means of peculiar organs for the formation of chyle." We have seen, that the outer bark becomes the calyx, the internal bark the corolla, the wood the stamina, and the medulla the pistillum; the fructification exhibiting the internal parts of a plant, naked and unfolded. We have likewise seen, that the fructification puts an end to vegetation in the part from whence it arises, stopping the progreſs of the medulla, which would otherwise have extended itself without end by the branches, and occasioning the division of that medulla into a number of seeds, each endowed with a separate living principle. But as the medulla exists naked in the germen, it cannot support itself, or make any farther progreſs, without the aſsistance of the cortical substance which it has left; it must, therefore, receive this aſsistance by some means or other, and, in fact, does receive it from the stamina and their pollen, which owe their origin to the woody matter derived from the inner bark, and originally generated by the outer bark. But if it happens that the cortical substance is able to invest the medullary rudiments of the seed in the flower itself, the plant becomes viviparous, as in *Festuca*, *Aira*, and *Poa vivi-*

As all seed-veſsels are destined to produce seeds, so are the stamina to bear the *pollen*, or fecundating powder. All seeds contain within their membranes a certain medullary substance, which swells when dipped into warm water. All pollen, likewise, contains in its membrane an elastic substance, which, although very subtile, and almost invisible, by means of warm water often explodes with great vehemence. While plants are in flower, the pollen falls from their antheræ, and is dispersed abroad, as seeds are dislodged from their situation when the fruit is ripe. At the same time that the pollen is scattered, the pistillum presents its stigma, which is then in its highest vigour, and, for a portion of the day at least, is moistened with a fine dew. The stamina either surround this stigma, or, if the flowers are of the drooping kind, they are bent towards one side, so that the pollen can easily find acceſs to the stigma; where it not only adheres by means of the dew of that part, but the moisture occasions its bursting, by which means its contents are discharged. What iſsued from it, being mixed with the fluid of the stigma, is conveyed to the rudiments of the seed. Many evident instances of this present themselves to our notice; but I have no where seen it more manifest than in the Jacobean Lily, *(Amaryllis formoſiſsima)* the pistillum of which, when sufficient heat is given the plant to make it flower in perfection, is bent downwards, and from its stigma iſsues a drop of limpid fluid, so large that one would think it in danger of falling to the ground. It is, however, gradually re-absorbed into the style about three or four o'clock, and becomes invisible till about ten the next morning, when it appears again; by noon it attains its largest dimensions; and in the afternoon, by a gentle and scarcely perceptible decrease, it returns to its source. If we shake the antheræ over the stigma, so that the pollen may fall on this limpid drop, we see the fluid soon after become turbid, and aſsume a yellow colour; and we perceive little rivulets, or opake streaks, running from the stigma towards the rudiments of the seed. Some time afterwards, when the drop has totally disappeared, the pollen may be observed adhering to the stigma, but of an irregular figure, having lost its original form. No one, therefore, can aſsent to what Morland and others have aſserted, that the pollen paſses into the stigma, pervades the style, and enters the tender rudiments of the seed, as Lewenhoek supposed his worms to enter the ova[*]. A most evident proof of the falsehood of this opinion, may be obtained from any species of *Mirabilis*, (Marvel of Peru) whose pollen is so very large, that it almost exceeds the style itself in thickneſs, and, falling on the stigma, adheres firmly to it; that organ sucking and exhausting the pollen, as a cuttle-fish devours every thing that comes within its grasp. One evening, in the month of August, I removed all the stamina from three flowers of the *Mirabilis longiflora*, at the same time destroying all the rest of the flowers which were expanded; I sprinkled these three flowers with the pollen of *Mirabilis Jalappa*; the seed buds swelled, but did not ripen. Another evening I performed a similar experiment, only sprinkling the flowers with the pollen of the same species; all these flowers produced ripe seeds.

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[*] The Abbè Spalanzani shows clearly enough, by several experiments, that the rudiments of the young plant exist in the unimpregnated seed; and that the perforation of the style is in many instances so fine as to be invisible. He does not, however, suppose that the style is ever impervious, as Monsieur Adanson does, who thinks the impregnation may take place by means of other canals. The ideas of both these authors confirm the Linnæan opinion, that an extremely fine exhalation only, paſses from the pollen to the embryo.—ED.

Some writers have believed, that the stamina are parts of the fructification, which serve only to discharge an impure or excrementitious matter, and by no means formed for so important a work as generation. But it is very evident, that these authors have not sufficiently examined the subject; for as, in many vegetables, some flowers are furnished with stamina only, and others only with pistilla, it is altogether impoſsible, that stamina situated at so very great a distance from the fruit, as on a different branch, or perhaps on a separate plant, should serve to convey any impurities from the embryo.

No physiologist could demonstrate *a priori*, the neceſsity of the masculine fluid to the rendering the eggs of animals prolific; but experience has established it beyond a doubt. We therefore judge, *a posteriori* principally, of the same effect in plants.

In the month of January, 1760, the *Antholyza Cunonia* flowered in a pot in my parlour, but produced no fruit, the air of the room not being sufficiently agitated to waft the pollen to the stigma. One day, about noon, seeing the stigma very moist, I plucked off one of the antheræ, by means of a fine pair of forceps, and gently rubbed it on one of the expanded stigmata. The spike of flowers remained eight or ten days longer; when I observed, in gathering the branch for my herbarium, that the fruit of that flower only, on which the experiment had been made, had swelled to the size of a bean. I then diſsected this fruit, and discovered that one of the three cells contained seeds in considerable number, the other two being entirely withered.

In the month of April, I sowed the seeds of hemp *(Cannabis)* in two different pots. The young plants came up so plentifully, that each pot contained thirty or forty. I placed each by the light of a window, but in different and remote apartments. The hemp grew extremely well in both pots. In one of them I permitted the male and female plants to remain together, to flower and bear fruit, which ripened in July, and being macerated in water, and committed to the earth, sprung up in twelve days. From the other, however, I removed all the male plants, as soon as they were old enough for me to distinguish them from the females. The remaining females grew very well, and presented their long pistilla in great abundance, these flowers continuing a very long time, as if in expectation of their mates; while the plants in the other pot had already ripened their fruit, their pistilla having, quite in a different manner, faded as soon as the males had discharged all their pollen. It was certainly a beautiful and truly admirable spectacle, to see the unimpregnated females preserve their pistilla so long green and flourishing, not permitting them to begin to fade, till they had been for a very considerable time exposed, in vain, to the acceſs of the male pollen. Afterwards, when these virgin plants began to decay through age, I examined all their calyces in the presence of several botanists, and found them large and flourishing, although every one of the seedbuds was brown, compreſsed, membranaceous, and dry, not exhibiting any appearance of cotyledons or pulp. Hence I am perfectly convinced, that the circumstance which authors have recorded, of the female hemp having produced seeds, although deprived of the male, could only have happened by means of pollen brought by the wind from some distant place.

No experiment can be more easily performed than the above; none more satisfactory in demonstrating the generation of plants.

## ESSAY X.

### *On Experiments and concise Observations.*

AS the aggregate of human knowledge consists of minute parts, which, abstractedly considered, appear of little consequence; yet when relatively viewed in their connection with the whole, they acquire sufficient importance to claim regard and attention. It is upon that principle that I have set apart a portion of every one of these Volumes for Experiments and concise Observations.

### 1. *On the Shim, for cleaning Stubbles**.

In the isle of Thanet they are particularly attentive to clean their bean and pea stubbles before they plough: a most commendable practice. For this purpose they have invented an instrument called a Shim. It cuts three or four feet at a time, skimming the surface in such a manner, that the weeds are easily collected by harrowing, which is a cheaper and much more effectual method than hand-work. When a crop is going to be put in, nothing can be worse than to plough in weeds: all root weeds are, by that means, planted rather than destroyed; and others, by choaking the plough, occasion a bad tilth, and very unsightly work. To clear, therefore, a bean-field entirely, before the plough goes into it, is a most admirable system of management.

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* By A. Young, Esq.

### 2. *On Vetches**.

The Vetch is a most excellent vegetable; and great advantages may be derived from it in various ways. If a piece of barley or wheat stubble, which comes in course for turnips, be found tolerably clear and mellow after harvest, it is a good practice to sow winter Vetches upon it, and harrow them in, as soon as the corn is off. They will often produce a great deal of valuable feed for ewes and lambs in the spring, when such kind of aſsistance is of inestimable value, and yet admit of the land being got into good order for turnips. They are likewise of great profit when cut green, in the course of the summer, and given to cows and working horses in the stable. An acre, cut and used in this way, will go farther, and do the horses more good, than two acres eaten off in the field: Working horses want rest; in the stable they are not teased by flies; besides, the quantity of manure which horses make, so foddered, is prodigious.

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* By Mr. N. Kent.

### 3. *On Speculations.*

It cannot be denied, but that many useful practices in Gardening and Husbandry have been the offspring of chance, yet it is no leſs true, that philosophers in their closets, have sometimes imagined new modes of promoting the art of cultivating plants, which being put to the test of experiment, have been found beneficial: And since the nature of air, water, and almost every other substance, has been more succeſsfully investigated, it may be expected that more valuable hints will be suggested in the closets of philosophers than was poſsible before, and that many of their new ideas will stand the test of experiment. This will be uniting philosophy and practice for their mutual advantage.

### 4. *On Paring and Burning* *.—*A Speculation.*

The argument used by those who condemn Paring and Burning, is, that it consumes the natural earth. Allowing this to be the case, and in some situations it may be admitted, might not the following practice obviate that objection? Pare the surface very thin towards the end of July, and instead of burning the sods, pile them into a large heap, with as much stable, or fold-yard dung, as the farmer can conveniently spare. The sods being removed and piled up, let the land have a superficial ploughing, and in consideration of its poverty, it will be proper to bestow upon it as much compost, or short dung, as can be spared. In this state, sow the land with the customary small seeds, to which should be added a portion of ray-graſs. Then harrow the land, to mix the soil and the manure, so as to make an equal bed for the ſeeds. In the following spring, it is expected that the land will appear to be well stocked with graſs. In this state, restore the earth taken from it, after having turned the heap once, in order that it may spread even over the young graſs. Some may think it better to sow winter tares, rather than seeds, and indeed the idea is not to be condemned; or rape may be sown, for feeding in the spring. In either method, the heart of the land will be preserved, which is what I contend for.

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* By A. Hunter, M. D.

### 5. *On the Roots of Couch-Graſs* *.—*A Speculation.*

It is well known that the roots of Couch-Graſs contain a large portion of saccharine matter; but in consequence of that plants being the farmer's bane, the roots seem to be laid aside and neglected. Cows, pigs, and horses, eat them with seeming pleasure after the earth is shook from them, but such provender is seldom given them, on the supposition that the roots will again appear in the dung. Such an opinion I cannot consider as well founded. Let us not expect, that this prejudice will operate against the roots when dried, and made into hay. This, I apprehend, may be done, but with an allowance of more time than is required for making clover into hay. As this experiment may be tried without expense, and with very little trouble, I flatter myself that it will be deemed worthy of attention.

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* By A. Hunter, M. D.

### 6. *On the Willow-Herb, or French Willow**.—*A Speculation.*

This plant is a perennial, and shoots early in the spring. Cows and horses eat it with seeming avidity. It delights in a moist soil, and is readily propagated, either in spring or autumn, by dividing its roots. I have not any experience of its springing after being cut, so that I wish this short account to be put down as a speculation not unworthy of notice.

### 7. *On Lucern*†.—*A Speculation.*

Having fixed upon a good loamy soil for the cultivation of this most useful plant, let it be prepared as for a crop of beans. In the month of March let it be drilled with beans, at the distance of two feet from row to row, and in the beginning of May, let these wide intervals be well horse-hoed for the destruction of the weeds then growing, as well as for loosening the soil for the reception of the lucern-seed. With the turnip-drill sow the usual quantity of lucern-seed in the centre of each interval. Protected by the warmth of the beans, the lucern will probably put out vigorous shoots during the first year, and in the succeeding spring, it will be fit to cut. In this manner, a year will probably be gained at a trifling expense.

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* By A. Hunter, M. D.

† By A. Hunter, M. D.

### 8. *A Garden Manure* *.—*A Speculation.*

Take about 50 pounds weight of rape-cake, in powder. A bushel of cow-dung. Put these into a wine pipe of water during the term of five weeks, occasionlly stirring them to bring on a degree of fermentation. To be used on borders where salads and annual plants are raised. A liquid compost similar to this is used in the gardens in Batavia. Upon this principal, many excellent manures may be invented for garden culture. Water more animalized, may be useful on pasture and meadow-land.

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* By A. Hunter, M. D.

### 9. *On Sowing Clover on a Barley Stubble*[*].—*A Speculation.*

As clover is generally sown with barley, it often happens that when the crop is heavy, the clover is much injured by being overshaded. It is therefore proposed, by way of experiment, to mow the barley-stubble as soon as poſsible, and to sow the clover-seed with the harrows, instead of sowing it with the grain in the spring, us usually practised. Some advantages may arise from this practice upon light sandy soils. Among other advantages, the barley crop will probably be better, for it must be supposed that the clover growing at the foot of the barley, must in some degree prevent the spreading of its roots. The land will also get another cleaning by the harrows.

### 10. *On Fell-Mongers' Poake*[†].

This manure has, for ten years past, been used upon the stiff grounds in the counties of Surrey and Kent, which lie contiguous to London. The farmer removes it from the fellmongers' yard in the dry months or hard frosts.

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[*] By A. Hunter, M. D.

[†] By John Gretton, Esq.

It is compounded of lime, hair, and scrapings of the pelts of sheep, &c. which have been dreſsed by the fell-mongers. There are two sorts, the white and the brown: the white is much the best, being more saturated with oil, lime, and hair; but they are both good, and go further in dreſsing land than any manure whatever, in the proportion of four to one.

The manner of preparing it for the ground is as follows:—Let your load be shot upon the head-land of the field you mean to dung; (which must have been previously ploughed up pretty deep) let it be spread upon this head-land six inches thick at least, and not more than twelve, in order that it may dry and swell, which it will do in about a fortnight; thus go on till you have covered three parts of your head-land out of four; at the end of a month you will have as much fell-poake as will dreſs and cover the remaining fourth of the head-land: of course it must be taken from the heap, and carried upon it, at least six inches thick; when this is done, the whole must be turned, adding as you turn it, as much of the head-land earth as could be got up to it: in this state let it rest at least one month, and not more than two. You may then cast it upon your fallows, either for turnips or wheat, in the proportion of ten or twelve large cart loads per acre. Land thus dreſsed, escapes the fly if in turnips, and the worm if in wheat. It holds in the land three years and upwards.

If you mean to have a potatoe crop, get your fell-poake on your head-land by the latter end of October at the farthest, that it may dry and swell sufficiently for the head-land to be turned up with it by Christmas at all events: upon this range I advise a layer of good dung, at least a foot thick, and that it should be all well ridged and spatted up, to prevent its letting in too much wet, or crumbling down, and wasting in the winter. Let this range be turned, and well chopped together in February; thus prepared, carry on your land in the proper season from twelve to fourteen loads an acre; spread it well, and plough it in with your last ploughing; then dibble in your potatoe sets, and lastly, paſs all over with a harrow, or not, just as the land lays. Thus also prepare for a barley crop.

It is to be observed, that if one head-land is not sufficient for finishing the field, you must take care to plough up another; for it sometimes happens the head-lands are narrow, and of course not sufficient to carry fell-poake and dung for the whole field.

In the course of five years experience, I have discovered the very valuable properties of fell-poake as a manure over every other kind. It has the peculiar property of swelling, as it dries, to nearly one-half of its original bulk, yet of retaining its vegetative quality when at work in land.

It is a most excellent manure, taken by itself, in all stiff and wet soils; in which case six or eight loads per acre is quite sufficient, as the heaps may be laid small, because they will swell to a proper size for spreading in a short time. The land thus dreſsed, resists all approach of the fly and slug. It does not afford (as is common with other lands) shelter or food for vermin. I never saw a mouse or mole where it has been plentifully used; neither the red nor the canker worm, so fatal to the young shoots of all corn. It meliorates and renders stiff land slippery and ductile, by breaking its adhesive quality; land of this description will soon plough as light and free as the most kindly loam. It communicates its vegetative, yet repellent qualities, to the torpid earth of head-lands or pit-mud, if care be taken to let the latter dry before it is mixed with it.

Its strength is equal to twice that of horse dung; it will hold in full power three or four, if not five or six years: in some lands it will extend to the latter. It is congenial to potatoes in a high degree; also to turnips, wheat, and barley. It is most excellent in destroying rushes and sedge in low wet meads. It is sure to destroy, and of course preserve, the roots of cabbage and cauliflower plants from the noxious effects of the worm, which perforates and clubs them: this I have also proved to a demonstration. Land dreſsed with it, mixed and well mingled with farm-yard dung and earth, as before stated, will produce one-fourth more than by any other manure.

Against all these advantages, I have only to say, I do not think it a fit dreſsing for light, loose, or thin land, whose bottom is chalk, gravel, or flint; but as I speak merely from conjecture, others are at liberty to try its effects, or not, as to them may seem best. My farm was stiff, upon a strong adhesive clay, and very holding land; but after I had used the fell-poake, sometimes singly and sometimes mixed, it soon yielded me profit on the one hand, and my horses ease on the other.

### 11. *On laying down Land to Pasture* *.

For this purpose I have tried several methods, and am convinced that the best is, to sow clover and graſs-seeds early in the autumn, without a crop. I sow no purchased hay-seeds, which I have always found mixed with the most noxious weeds. In the month of August, 1791, I laid down six acres, on two of which I sowed the meadow fox-tail, and the meadow fescue, Dutch clover, and a little rib-graſs. Last summer it produced a prodigious quantity of graſs, and is now (1793) equal to the best old pasture, worth 40s. per acre. On the other four acres, I only sowed clover, rib-graſs, and trefoil; as I rather chose to trust the natural graſs of the soil, than to sow hay-seeds full of weeds. These four acres are good pasture, but not equal to the other two, as they do not abound with those two excellent graſses, the meadow fescue, and the meadow fox-tail, which for early growth, sweetneſs, and great produce, I esteem far above all other graſses.

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* By Montagu Burgoyne, Esq.

### 12. *On the comparative produce of different Vegetables under Field-culture**.

Observing that the comparative produce of potatoes, carrots, cabbages, and turnips, had not been ascertained, I was desirous to know the relative weight per acre of these four useful vegetables: with this view I weighed a square rod of each, and found them to be as follows:

A rod of potatoes 168lb.—An acre 26,880lb.; or 12 tons.

A rod of carrots 260lb.—An acre 41,600lb.; or 18 tons, 11 cwt. 48lb.

The cabbages weighed, on an average, 5lb. each, and as they stood two feet apart each way, there were 11,025 cabbages, which weighed 55,125lb.; or 24 tons, 12 cwt. 21lb. per acre.

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* By Montagu Burgoyne, Esq.

A rod of red turnips 131lb.—An acre 20,994lb.; or 9 tons, 7 cwt.

A rod of white turnips 150lb.—An acre 24,080lb.; or 20 tons, 15 cwt.

### 13. *On Tares as an Artificial graſs**.

In Suſsex, arable lands, tolerably clean, and in good heart, or rendered sufficiently so with manure, are ploughed in September or October, and sown with winter Tares, which are fed off in April or May with sheep. The land is then ploughed in, and spring Tares are sown for feeding in autumn. In this manner, two crops are gained instead of an unproductive fallow. Upon rye-graſs and trefoil layers, instead of a bastard fallow, as in Norfolk, they sow spring tares and rape,—a bushel of tares and a gallon of rape, which are fed in autumn with sheep. One acre and twenty-nine perches of such a crop, have been found sufficient for four hundred ewes for a week; which at 2d. is 3l. 6s. 8d.; the value of the fold 1l. 5s. together 4l. 11s. 8d.

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* By A. Young, Esq.

The whole range of British husbandry, perhaps, does not offer a more valuable instance of excellent management than that which is here described. I may remark that the same management is pursued when tares are used for soiling the teams in the stable. The winter sort are ready the end of May or beginning of June, and as fast as the land is cleared, it is ploughed and instantly sown, in regular succeſsion, with the spring sort; by which means, soiling goes on from June inclusive to November. The whole buſineſs of the system of tares is perfect, and merits imitation in every part of the kingdom.

In Wiltshire, spring vetches are sown on the Downs in ſucceſsion during the spring months, so as so come in at different times of the summer. In the County of Gloucester, tares are sown for feeding sheep, which are put on them the latter end of May, or beginning of June. They are usually hurdled off in the same manner as turnips; but if a bulky crop, they give them through rack-hurdles, which are made the same way as the common five-railed ones, only leaving the middle rail out, and nailing spars acroſs, at proper distances to admit the sheep to put their heads

through. A swarth of vetches being mown across the land, a sufficient number of these hurdles, allowing one to five sheep, are set close to it. At noon, the shepherd mows another swarth, and throws it to the hurdles; and the same at night. Next morning, the swarth being first mown, the hurdles are again set. In this way the vetches are clean eaten. As fast as cleaned, the land is ploughed, and sown with turnips; sometimes with spring vetches.

### 14. *On River Weeds for manure*[*].

River weeds, as a manure, are I believe almost totally neglected, which, if when cut were to be collected together, by driving in stakes at proper distances in the rivers, or at the head of mills, such quantities may be obtained throughout the kingdom, as would be sufficient to manure many hundred acres annually. Last summer I had a considerable quantity taken out of the head of a mill on the river Test, and laid in a heap upon the bank to drain and ferment, which they did to a surprising degree; after shrinking from one third of their original bulk, they were reduced to a

very high degree of putrefaction, breeding an amazing variety and multitude of insects; in this state they were carted on two small pieces of land, containing together about two acres and a half, designed for wheat in a common field. The land had been previously folded over by the tenantry stock; the wheat has evidently the superiority in point of groſsneſs and colour to the rest of the field. The expense of collecting the weeds was two pounds, which, from the excellence and quantity of manure they afforded, is a very cheap improvement; I have for this fortnight past been employed in pulling them out in several places along the river, and purpose doing so during the summer.— Understanding that cattle were fond of them, I ordered my man to try whether the cows would eat them; accordingly, three and twenty cows and oxen were served with them. They all eat them, though some fed upon them with greater avidity than others. I perceive that young cattle like them best when they have lain a day or two to drain, than when fresh cut off the water, they being then too cold for their stomachs and apt to blow them. There is a labouring man in my neighbourhood, who keeps two cows almost entirely with river weed; he says that his cows give a greater

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through. A swarth of vetches being mown acroſs the land, a sufficient number of theſe hurdles, allowing one to five sheep, are set close to it. At noon, the shepherd mows another swarth, and throws it to the hurdles; and the same at night. Next morning, the swarth being first mown, the hurdles are again set. In this way the vetches are clean eaten. As fast as cleaned, the land is ploughed, and sown with turnips; sometimes with spring vetches.

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quantity of milk than when fed with graſs; but thinks that their milk is not so rich from weeds as graſs; his cows are in fine order, and so greedy after weeds, that he is obliged to abridge them in the quantity for fear of their being blown, as has sometimes been nearly the case, owing to the family serving them again after he was gone to work, not knowing that they had been previously fed.

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[*] By Mr. Thomas Barnard.

### 15. *On Sowing Turnips*[*].

When there is a neceſsity for sowing the seed in a dry season, begin in the morning, as soon as it is light, to plough for sowing the seed, and plough only so much as can be sown and harrowed by six o'clock in the morning. At six o'clock in the evening, begin again to plough as much land as can be sown and harrowed before it be dark, and thus proceed till the whole be sown. The seed being sown when there is moisture in the newly ploughed ground, will vegetate sooner and come up more regularly than it would do if sown when the ground is dry; but if the season be moist, there will be no need of such early and late ploughings. Should the fly attack the turnips, in consequence of dry weather, the best preservative is to sow a quantity of vegetable ashes over the field, and in the evening of the same day to paſs a roller over it; for this purpose, the provident farmer will provide himself with a sufficient quantity of dry ashes, which, if not used in this manner, may otherwise be beneficially applied.

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[*] By Mr. Thomas Barnes.

### 16. *On Coal-Balls*[*].

About Bristol, Brislington, and other places of the west of England, they make coal-balls of their culm, or small refuse coal, which could not otherwise be saleable. The way in which those balls are prepared, is to take a certain quantity of the culm, to which they add an equal quantity of sleech, or mud, which the tide leaves on the sea-shore. After mixing them well with shovels, they blend them with their hands more perfectly, and mould them into balls of six inches in diameter; and, in making them up, they work as much culm into the sleech with their hands as they possibly can, without making them crumbly. These balls may be burnt immediately; or they may be laid up, and kept as long as the owner pleases. This kind of fuel makes a pleasant, fierce, and good fire, and emits no disagreeable fumes. Coal-balls are made in Wales, particularly about Carmarthen, in another way. Instead of sleech, they use clay, allowing two parts culm to one of clay. To the heap they add a sufficient quantity of water, tempering all together in the manner of mortar. When sufficiently mixed, they form the whole into balls. Those last mentioned balls, made with clay, do not make so pleasant a fuel as those made with sleech, because the clay is apt to send forth a stinking smoke, especially if the balls be used before they are dry; yet, notwithstanding this inconvenience, they make a cheap and good fuel.

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[*] By A. Hunter, M. D.

### 17. *The Irish Method of raising Potatoes*[*].

Lay the potatoes whole, or cut, upon turf, at about twelve or fourteen feet asunder, and upon beds of about six feet wide, on each side of which a trench should be opened, about three feet wide, and the turf that comes from thence should be laid, with the grafs-side downwards, upon the potatoes; a spit of mould should next be taken from the trenches, and be spread over the turf, and in like manner the whole plot of ground, that is designed to be planted, must be treated: when the young shoots appear, another spit of mould from the trenches should be strewed over the beds, so as to cover the shoots; this will prevent the frosts from injuring the tender shoots, will encourage them to spread, and totally destroy the young weeds. Future earthings-up to be discretionally used. When the potatoes are taken up in the autumn, a careful person should return the earth into the trenches, so as to make the surface level. From the same ground a better crop of potatoes may be obtained the following year. The ground being fresh, no manure seems to be required for the first year's crop; but this mode can only be adopted where the staple of the soil is deep and rich.

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[*] By Mr. J. Hazard.

## 18. *On shutting up Pastures in Autumn for Spring Feed*[*].

The graſs of the preceding hay crop, or pasturage, kept from July or August, without suffering any animal to enter it, is in Suffolk called old *Rowen*. It is eat bare, previous to its being freed from stock, which should not be later than from the middle of September to old Michaelmas. This reserved graſs forms a certain, wholesome, and nutritious food for ewes and lambs in early spring, and is the farmer's sheet-anchor, being greatly preferable to turnips, or any thing denominated spring feed.

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[*] By Mr. Marshal.

### 19. *To destroy Root Weeds**.

It is a judicious practice to employ women to follow the plough, especially in fallowing, to pick up the root weeds, particularly the dock. The expense is trifling, and, in some cases, the benefit is invaluable. At the same time, children may be profitably employed in picking up the couch graſs, which will be a great aſsistance to the harrows. No man deserves the honourable appellation of a farmer, who does not consider himself as at perpetual war with weeds of all denominations, whether growing upon his own lands, or flourishing in the high-ways, ready to annoy him with their winged seeds. When the lanes belonging to a farm are infested with thistles and other weeds, we may pronounce the owner to be a careleſs, if not a very ignorant farmer.

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* By A. Hunter, M. D.

### 20. *On Sugar-Manure*[*].

The skimmings of Sugar under refinement, is found to be a rich manure. Three loads of earth, and one load of the Sugar skimmings, which consist of American clay and saccharine particles, make four loads of a rich and durable manure.

### 21. *On Gooseberries*[†].

The best Gooseberries now under cultivation, had their origin in the county of Lancaster; and to promote this spirit, meetings are appointed in different places at which premiums are adjudged for flowers and fruits. These meetings are encouraged by master-tradesmen and gentlemen of the county, as tending to promote a spirit that may occasionally be diverted into a more important channel. The competitors for prizes are generally mechanics, who, after the toilsome labours of the day, retire to their cottages and small gardens, from which they derive both pleasure and profit. A single Gooseberry-tree, the Manchester rough red, in the year

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[*] By Mr. John Holt.

[†] By A. Hunter, M. D.

1792, produced twenty-one quarts of fruit in the green state, and which sold for 3d. per quart. The whole quantity weighed twenty-eight pounds avoirdupois. The space occupied by this tree was three yards; allowing an equal space for walking ground, and supposing an acre (of eight yards to the rod,) planted with the same kind of trees, and producing the same quantity of fruit, and sold at the same price, the annual produce would amount to 426l. 16s. Great care is taken in pruning the trees. In general, Gooseberry bushes bear their fruit on the second year's wood. Care should be taken in summer to keep the middle of the bush clear, to admit of a free circulation of air, leaving the finest and strongest shoots from six to ten inches distant from each other. This will help to ripen and harden the wood.—It is a practice with some, to shorten the shoots in the autumn or winter pruning: this should always be near to a wood bud, which may be known by its being single; whereas fruit buds are in clusters. The shoots may be shortened to eight or ten inches, according to their strength. Observe, that those branches which were cut the first year, will, on the second, throw out spurs which produce the fruit. Gooseberries are much infested by a small green caterpillar, which frequently devours both leaves and fruit. They take their first station on the edges and undersides of the leaves. Their first appearance should be carefully watched. Lime-water, mixed with urine, is said to destroy them. Tobacco water is also recommended, if used at an early stage. Shaking the tree suddenly and briskly, will dislodge the caterpillar, when full grown; but unfortunately they will have produced much mischief before that time. As Gooseberries love a rich soil, they should be dunged every year, or at least have a good coat of dung once in two years. They should stand clear of trees, if the fruit is expected to be high-flavoured; and in spring, or summer, all suckers should be removed, leaving the stems clear and unencumbered.

### 22. *To preserve Walnuts* *.

Walnuts, for keeping, should be suffered to fall off of themselves, and afterwards laid in a dry and open airy place, till they are thoroughly dried: Then pack them in jars, boxes, or casks, with fine clean sand that has been well dried in the sun, in an oven, or before the fire, in layers of sand and walnuts alternately; set them in a dry place, but not where it is too hot. In this manner they may be kept good till the latter end of April. Before they are sent to the table, wipe the sand clean off; and if you find that they have become shrivelled, steep them in milk and water for six or eight hours before they are used; this will make them plump and fine, and cause them to peel easily.

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* By Mr. Wm. Forsyth, F. A. S.

### 28. *On Heading down Fruit Trees**.

When young trees are planted out from the nursery, as soon as they begin to break in the spring, they are cut down to three or four eyes, according to their strength, to furnish them with bearing wood: if this were not done, they would run up in long naked branches, and would not produce one quarter of the fruit which they do when this operation is properly performed. The same holds good in heading all kinds of old trees.

An opinion prevails, particularly in those parts where apple-trees are cultivated to any considerable extent, that trees never bear well after heading down, and that it frequently kills them. This, no doubt, may happen when they are improperly headed down all at once, by giving a sudden check to the sap, the few weak shoots not having strength to draw up what is supplied by the roots: And, moreover, not being capable of sheltering one another, they are chilled by the cold, and so rendered at least unproductive, if they are not totally killed. But if heading were done gradually, that is, if every other branch all over the tree were headed at a proper length, cutting as near to those parts where the shoots appear as poſsible, in the month of February or March, or even as late as May, in the course of the summer they would throw out fine strong shoots. These should not be shortened the first year, unleſs it be neceſsary to shorten a few to fill up the head of the tree with bearing wood, and that should be done in the following spring; cutting them to six or eight inches long, according to their strength. In the next spring, after the first branches are headed, the remaining old branches may be cut out; and these will soon fill the head of the tree with fine bearing wood. In three years, if properly managed, trees, so headed, will produce a much greater quantity of fruit, and of a better quality, than they did before the operation was performed.

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* By Mr. W. Forsyth, F. A. S.

### 24. *To raise early Potatoes at a small Expense* *.

Prepare the ground for planting the round early Potatoe, which should not be sooner than the middle of July. In consequence of this late sowing, the Potatoes will not be above three-fourths grown in the month of October. In that unripe state, cover them well with earth taken from the alleys, which should be made wide, for the purpose of affording a sufficient covering. Ram the earth well down to keep out the frost and wet during the winter months. Early in the spring, the Potatoes may be taken up, and as they were not permitted to arrive at maturity, their skins will be thin, resembling early Potatoes raised at a great expense.

### 25. *On Water-Meadows* †.

It is matter of surprise, that Water-Meadows are so little known in the northern parts of this island, especially as there is hardly a district where they may not be formed with advantage. Such gentlemen as have lands that are capable of being artificially flooded, will find it best to send into those countries where Water-Meadows are well understood, for experienced persons, rather than trust to their own agents, whose knowledge can only be collected from books: And I most earnestly recommend this mode of proceeding in all cases where a new improvement is to be brought from one country to another.

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* By A. Hunter, M. D.

† By A. Hunter, M. D.

It is of the utmost importance for the farmer to have early graſs for his ewes and lambs, and no method, hitherto known, (Water-Meadows excepted) does effectually provide him with it. It is not neceſsary that the water employed should come from a river, or be loaded with earthy particles, as pure spring-water, when drawn over the surface of graſs grounds during winter, and kept continually gliding, is found of equal use: I have often remarked, upon heath lands, where springs frequently break out, that the earth which receives the water is full of verdure at an early season; and at the same time I have observed, that the heath was effectualy killed in all places over which the water had spread. From this we may conclude, where circumstances will allow, that drawing water from the high springs, over dry and barren heaths, will bring them sooner into cultivation, than the expensive methods now practised of paring and burning the surface, as preparatory to the plough.

### 26. *On Soot used upon Graſs Grounds*[*].

I find Soot a very useful manure for graſs grounds. The quantity, per acre, should not be leſs than six quarters—and this succeeds best if laid on just before rain. The month of March is the best season. I have remarked upon this excellent species of top-dreſsing, that it occasions the graſs to spring more early than common dung, and sheep are remarkably fond of the produce. Besides its other properties, soot is known effectually to destroy moſs, a most pernicious vegetable in graſs grounds.

### 27. *On securing Apple Trees from Cattle*[†].

The difficulty and expense of securing apple-trees, &c. when planted, from cattle, is so great, that this circumstance alone has discouraged many perſons from attending to this profitable branch of husbandry. Mr. Samuel Part and Mr. William Strettell, both of Pendleton, near Manchester, have planted very great numbers of fruit-trees on their estates; and they both declare, and are ready to convince any persons that may wish to be more certainly informed concerning it, that they have pursued a method of fencing off their fruit trees from cattle, without the expense of stakes, rails, or thorns. Their receipt is this:

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[*] By Stanhope Harvey, Esq.

[†] By T. B. Bayley, Esq.

"Take lime, that has long lain at the bottom of a tan-pit; mix this in a tub, with fresh human ordure, so as to make it of such a consistence that it may be laid on the stems and branches of trees by a small-sized brush, such as is used by white-washers: Or it may be daubed on shreds of baſs maſs, pieces of old rope, &c. to be tied round the stems and branches from the bottom to the top. This must be renewed twice in a year, or three times at the most, and is comparatively of no expense or trouble."—Cattle will not come near or injure the smallest or tenderest plant that is daubed with this mixture, according to Mr. Part and Mr. Strettell's report, which I have every reason to credit. Something like this practice was recommended above an hundred years ago, by the celebrated Sir Hugh Platt, and Mr. Evelyn. Sir Hugh, in his "Garden of Eden" gives the following: "Mix green cow dung and urine together; wash the trees with a brush so high as you think meet, once in two or three months, and it will keep the trees from barking with beasts, conies, &c. and the same doth also destroy the canker." Mr. Evelyn says, "Deer, conies, and hares, by barking the trees in hard winters, spoil many tender plantations: Next to the utter destroying them, there is nothing better than to anoint that part which is within their reach, with *stercus humanum*, tempered with a little water or urine, and lightly brushed on: This renewed after every great rain; but a cleanlier than this, and yet which conies, and even cattle most abhor, is to water or sprinkle them with tanners' liquor, viz. that which they use for drefsing their hides."

### 28. *On mowing green Oats**.

Very early in the spring I sowed five roods of good land with oats and hay-seeds. The crop was so luxuriant, and so full of weeds, (especially the fat-hen,) that towards the end of June the seeds were nearly smothered. At this time I mowed about a rood of the worst part of the field, and gave the green oats, together with the weeds, to my cows. In the following summer there was more graſs upon this part than in the whole field besides. All things considered, I should have been a considerable gainer if I had mowed the whole field in June. From this experiment some useful conclusions may be drawn.

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* By Mr. Skipwith.

### 29. *On the Skim Plough* *.

I consider Mr. Duckett's skim-coulter plough as one of the best implements ever invented. It is most effectual, and applicable to a great variety of purposes; but to none more than the breaking up old graſs. Every one knows, that when this is done with a common plough, there is between every furrow a seam of graſs and weeds, that vegetate through the summer, and injure the crop; but this is entirely prevented by the skim-coulter, which is applicable to every sort of soil that does not contain on the surface impediments of rocks or stones.

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* By the Rev. A. Young.

### 30. *On the cultivation of Clover* *.

A neighbour of mine, who is a very good farmer, had a field containing thirty-eight acres, the soil a cold wet clay, which, for some years after he held it, scarcely paid its rent. Determined, however, to try what could be done with it, he under-drained it, and in the spring, 1778, mended it with turf-earth taken from the borders of fields and high-ways, mixed with stable-dung. In March he gave it a good ploughing, and sowed it with Zealand barley: After the barley came up, he threw in ten pounds of the common red clover per acre. The advantage of the under-draining and manure, were soon apparent. The barley was an exceeding fine crop, producing seven quarters per acre, on an average, throughout the field.

The following spring the clover shot early, and in the summer proved a strong crop. In May he turned in all his cattle, which, to the 10th of June, had fed it off quite bare. He then took them out, and let the clover stand for seed. The summer proving wet, it succeeded well, and the average produce of the field was seven bushels and a half per acre; the whole of which he sold at 39s. per bushel, amounting to 555l. 15. As soon as the seed was off, he ploughed the field for wheat, and sowed it broad-cast with the red Lammas kind from Kent. The crop was excellent, and the produce four quarters per acre. With the same husbandry, I had last summer thirty-nine bushels of clover-seed from three acres of land, notwithstanding the dryneſs of the season, but the land was somewhat better in quality.

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* By an Eſsex Farmer.

### 31. *A View of the Parish-Schools in Scotland, together with an Account of the Parish-Poor.*

In every parish throughout Scotland, a provision is made for a schoolmaster as regularly as for the parson. A house and convenient offices, in all country parishes, is built for the parson, and a school-house and house for the schoolmaster, at the expense of the proprietors of the parish. To the last also is attached a suitable garden, and a small salary in money, usually about five or six pounds a year. The person appointed to this office is called the pariſh ſchoolmaſter, and is under an obligation to open a ſchool for the purpoſe of instructing ſuch of the young children in the pariſh, as their parents chooſe to ſend thither, to read and write, and caſt accounts, as well as to read the Latin language, if they ſo incline. For this he is entitled to demand certain fees, which vary in different parts of the country, but all of them extremely low. In general, no more than fourteen pence a quarter is demanded for each ſcholar for being taught to read; half a crown for writing and accounts; and the ſame for Latin; though it is cuſtomary for the parents to pay five ſhillings for the laſt. It is very common among thoſe who are not of the loweſt claſs of labourers, to make ſome preſents occaſionally to the teacher, over payment, as a teſtimony of good-will, when the ſchoolmaſter gives ſatiſfaction. In this way, if he be aſsiduous, and well-beloved by the pariſh, he can make a moderate living among them, but can never riſe ſo high as to enable him to diſpenſe with the drudgery of teaching. It is owing to the univerſality of this eſtabliſhment, and to the ſmallneſs of the ſchool-fees, that education is brought within the reach of the lower claſses of the people in Scotland ſo univerſally, that unleſs it be in the Highland districts, where many of the parishes are of very large extent, there is scarcely to be found a single individual any where who has not been taught to read; and few among the young persons, especially boys, who cannot write and cast accounts also. Most of those, however, among the claſs of labourers, are taught to write after they are grown up, so as to be able to pay for it themselves; it being a practice very common to have an evening school for that purpose, where none but such young men do attend. To this institution also we must ascribe the peculiarity, that here you can scarcely meet with a farmer's son who does not understand a little of the Latin tongue also; though it must be admitted, that their knowledge in this last is in general so slight, as to entitle them to no other epithet than that of smatterers in the language. But the lower claſses universally read the Bible with ease, and study it with unremitted attention, so as to be acquainted with its contents in a much more accurate manner than some of those in other nations whose duty it is to teach and expound the scriptures. There is no family above the rank of a labourer that has not a family Bible, which usually descends from father to son for several generations, and is of course preserved with care, and only opened with reverence at times by the father of the family, when he reads and expounds it to the younger ones and servants, and performs family worship, each individual at the same time making use of his own particular Bible. It is easy to conceive, that a practice of this sort, being very general, must have a great effect on the manners and conversation of the common people; and all this must be originally traced, in a great measure, to that simple institution which I have just noticed. The income of the parish schoolmaster is usually augmented, in some degree, by his being appointed to the office of parish-clerk, with a small salary annexed to it, besides certain fees of office, which, though small, when individually considered, amount to something when united into one aggregate sum. In consequence of this moral system of education, the young people are brought up with the laudable pride of depending upon their own exertions for support; and when that fails, in consequence of old age, or any other inevitable calamity, they are sure to find protection from their own children, or nearest relations. In this country, compulsory parish-rates are unknown, and those who receive alms from the parish are few in number, consisting entirely of old people who have never been married, childleſs widows, and others of a similar description, who have survived their nearest relations that were younger than themselves; for no child who has the smallest respect for his character, will ever submit to see either of his parents come upon the parish, while he has health and strength to earn an ordinary day's wages. It is a principle with persons of the lowest condition to lay by for the winter season some part of the earnings of summer and harvest. But as parishes, especially in towns, must be occasionally called upon for the relief of indigent persons who have neither friends nor relations, every parish is in poſeſsion of a fund sufficient to answer the purpose of such preſsing occasions. The following is the mode universally adopted for the formation of such a fund. In the porch of every church, there is placed upon a stool, covered with a clean napkin, a neat pewter plate, into which, on a Sunday, every person throws in a piece of money, as his inclination prompts, or his circumstances permit him to do; but this is by no means compulsory on any one. After service, the money collected is carried by the churchwardens, there called Elders, and deposited in an iron chest, in the presence of the minister and parish-clerk, who regularly enters the amount of the collection into a book kept for the purpose. Besides these voluntary oblations, there is usually appropriated a part of the church, the seats of which are let, and the rents arising from them are carried to the fund. Farther, there is usually one or more mort-cloths bought with the poor's money, for which each person who uses it pays a certain stipulated fee, which is also carried to the ſame fund: some other devices of a similar tendency are carried into practice in different parishes; and all these items, together with occasional voluntary donations from pious persons, and interest of money lent, constitute the ordinary poor's fund. The whole of the monies so collected, is put under the immediate management of the Minister and Elders of the pariſh, who, without fee or reward, distribute it to the poor according to their wants. These accounts are subject to the inspection and controul of every landholder in the parish, afterwards to the *synod*, (a church judicature consisting of ten or twelve parishes,) and from thence, in case of challenge, to the general aſsembly, or, by appeal, to the Court of Seſsion. These funds, being thus managed with great integrity and economy, are found altogether adequate to the purposes required,

### 31. *On Osiers**.

There are some flourishing Osier grounds near London, situated on the banks of the Thames. The quick growth of these aquatics allows them to be cut every year. The cuttings are sold to the basket-makers, in bundles measuring 42 inches in circumference, at 1s. and 1s. 6d. per bundle. The basket-makers will willingly give 5l. an acre for a good Osier-ground, though situated at the distance of ten or twelve miles from London. But the produce of a good bed will frequently amount to 10l. per annum. Considering the small expense neceſsary for supporting the Osier-bed, and that neither the plough nor manure are required to produce an annual crop, there is reason to believe, that land adapted to the growth of aquatics, will insure a larger profit when planted with Osiers, than in any common mode of cultivation.

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* By A. Wilkinson, M. D.

The *Salix Vitellina*, or Golden Willow, and the *Salix Viminalis*, or Green Osier, are the sorts used by the basket-makers. The annual growth of these will frequently exceed six feet.

### 32. *On Compost Dunghills*[*].

Compost Dunghills furnish a supply of manure, when a sufficiency of animal dung cannot be obtained. They consist of earth, scourings of ditches, road soil, peat-moſs, moſsy earth, lime, and dung, and such other kinds of vegetable substances as can be easily got, such as quick roots gathered from the land, fern, leaves of trees, nettles, and thistles from the lanes. These are all mixed and repeatedly turned over, and suffered to lie and rot for several months, perhaps a year, before the compost is laid upon the land.

In forming Compost Dunghills, consideration should be had to the quality and state of the land for which they are intended. If it be a thin, light, gravelly, or sandy soil, the proportion of earth may be increased to any quantity that can be got, or carried to the ground; and it may consist of clay, moſs, and good earth of any kind that it is not sandy or gravelly. In this case, though the dunghill may not be rich in proportion to its size, yet as it will contain the same quantity of lime and dung, and vegetable substances, convertible into dung, and to be spread no farther than if this extraordinary addition of earth had not been made, it will bring upon the ground a sufficient quantity of manure; and, at the same time, by the great proportion of earth it contains, it will serve to deepen the soil, and render it more tenacious of moisture. When intended for strong land, and of a good quality, the Compost Dunghill need not contain so large a proportion of earth, whilst the same quantity of the richer materials is allowed. When designed for a stiff clay, or moſsy soil, instead of clay and moſs, which are proper in the first mentioned case, sand and gravelly earth ought to be employed.

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[*] By John Thompson, D. D.

Farms having easy acceſs to lime and peat-moſs, can always have plenty of manure. By compounding these in proper proportions, and adding a certain quantity of dung, excellent manure may be formed: The effect of the lime, and the juice of the dung, being to perfect the putrefaction of the vegetable substances of which the moſs is composed.

It may not be improper to mention the method of making up this compost. The lime and moſs ought to be in the proportion of one cart load of the former to five of the latter, and the dung one-fourth of the original compound. When the moſs and lime are mixed, the moſs ought to be tolerably dry, and the lime new slaked and hot. This mixture, after lying three or four months, should be turned over; and in five or six months after, turned a second time. At this second turning, the dung ought to be added. After having received the dung, it should not lie above three weeks, before it be laid upon the land. In some cases, the natural qualities of the composition may require it to be thrice turned, and to lie twelve months before it be used. Thirty cubical yards of this compound, per acre, will be a sufficient dreſsing for turnips, and forty for wheat.

### 33. *On Sea-Weed*[*].

Upon the sea coast this manure is obtained in considerable quantities. It is cast on shore by the waves, especially in the time of high tides, or in stormy weather. When carried to the land, it is usually spread immediately, as allowing it to lie in heaps for any length of time, is supposed to leſsen its efficacy. In Scotland, it is used for crops of all kinds, and forms an excellent manure; but is reckoned not so lasting in its effect as dung. It is found to be a good dreſsing for graſs; and indeed, in every case, it is judged best to apply it to the surface, without ploughing it in. When spread and exposed to the weather, it soon diſsolves and mixes with the soil.

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[*] By John Thompson, D. D.

### 34. *On Weeds**.

Weeds ought to be considered as robbers that pilfer the food which is neceſsary for the support of the more valuable and useful vegetables, and therefore ought, by all means, to be destroyed. Or, if their total extirpation cannot be accomplished, their propagation, at least, ought to be checked, and their numbers diminished as much as poſsible. The weeds most commonly to be met with, and which, at the same time, prove most injurious to the land, are the thistle, the dock, rag-weed, wild mustard, spurry, couch-graſs, knot-graſs, crows-foot, poppies, and some others. To destroy these, and every other noxious weed, summer fallowing, and horse and hand-hoeing, with drilled crops, are the most common and most effectual methods employed.

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* By John Thompson, D. D.

The thistle, the dock, and other large weeds that appear among growing corn, are either pulled up by the hand, or cut by the weed-hock.

It is to be observed, however, that through indolence or hurry of other buſineſs, they are often allowed to escape. It is painful to see the servants sometimes employed in extirpating thistles growing amongst the young corn, whilst those that grow by the sides of contiguous roads and ditches, or in the neglected corners of the fields, are suffered to remain unmolested. And as the rag-weed equally infests the pasture ground, it is equally disregarded. If poſsible, all kinds of weeds ought to be destroyed before they run to seed, but more especially those that have winged seeds. When these seeds are allowed to ripen, they will be scattered by the winds over the adjacent fields, and prove the source of much trouble and vexation to the farmer.

### 35. *On making Composts*[*].

Too much attention cannot be paid to compost in its several stages and operations. I have found that the art of making compost should be studied with due attention, and that the difference of the value of compost properly managed, and that made in a common and negligent manner, is to a farmer a very serious consideration. The method of managing compost, which I have practised with profit and succeſs, is as follows: I previously prepare the materials, and, according to the quantity of each material, proportion the thickneſs of each layer, not making any of them more than six inches; laying first a layer of one material, and then of another, and so on alternately, gradually decreasing the breadth of the heap, until it is reduced to a point at the top, forming an angle. If the materials are likely to be tardy in beginning to ferment, I put a few lumps of quick-lime into each layer, and beat the sides of the heap with a spade to keep out the weather. I then attend its fermentation with as much care as a brewer does his liquor, and the moment I find that the heat begins to abate, I turn the heap over, chopping it very fine. I throw the outsides and bottom into the middle of the heap made by turning, preserving the same form as before, and again beating the sides to keep out the weather. By turning the heap while it is yet hot, a fermentation takes place in the second heap, and by throwing the outsides and bottom of the first heap into the middle of the second, the whole maſs becomes completely putrified: All weeds and extraneous matter are destroyed by the fermentation, and the compost is in a perfect state when it has lain about two months after the last turning, and presents a maſs of matter superior, as manure, to any other. Keeping the weather out of it is a material point; but to keep up the fermentation, until the whole maſs has fully partaken of its effects, is the great object to be attended to.

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[*] By Mr. Greenall.

By making all manures into compost with earth, (of which uſeleſs banks, copse, cleaning of water-courses, gutters, ditches, &c. in general offer a sufficient quantity,) the soil which is lost by a variety of means when lands are under tillage, is replaced, and the thickneſs of the soil rather increased.

### 36. *On Paring and Burning*[*].—*A Speculation.*

To obviate all objections to this practice, I propose it as a judicious and profitable plan, to give the land a dreſsing of compost as soon as the ashes are spread. Let the land be immediately ploughed. The farmer may then proceed in the manner most agreeable to himself. The land thus strengthened by means of the compost, will be in condition to produce a better crop, than if no such dreſsing had been applied; and though this practice will be attended with additional expense, I am persuaded that in the end it will fully answer the expectations of the farmer.

### 37. *On Sainfoin*[†].

Great caution is neceſsary in the choice of the seeds of this plant, for it is a fact not generally known, that Sainfoin-seed, more than a year old, will not vegetate; and, therefore, it

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[*] By A. Hunter, M. D.

[†] By E. Cleaver, Esq.

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growth of Sainfoin, as common dung
generally too many other graſs-seeds in it; and this plant will admit of no rival to come near it.

### 38. *On the Senecio Jacobæa, or Ragwort* *.

Few plants are more hurtful to pastures than the common Ragweed, which, if once established in a field, can hardly ever be entirely extirpated; and when it has once spread through a vast district of country, can scarcely be banished from a particular field: But nothing is more easy than to eradicate it entirely, when it first makes its appearance in any part of the country where it did not for-should always be bought where you can be upon a certainty. I have been repeatedly imposed upon by seedsmen, as it is difficult to distinguish the difference between old and new seed, except by experiment, which comes too late. For this reason, seedsmen ought not to have any seed in their poſseſsion in the months of May, June, and July, for such seed can answer no other purpose than that of fraud or deception, since, if used, it will be the certain means of destroying the farmer's crop.

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* By James Anderson, L.L. D.

As it has generally been supposed by the farmers, that Sainfoin is not a native of England, I am enabled ro rectify that mistake, by referring them to North Burton Eastfield, near Bridlington, where it is to be seen in abundance, and growing quite naturally. The Hon. Thomas Howard of Ashstead, introduced it into the British husbandry about eighty or ninety years ago. The late Sir William St. Quintin, and my Father, were the first promoters of it in this neighbourhood *. Such is the excellence of this valuable plant, that it merits almost a volume to be written in its praise.

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* Castle Howard.

I am the more particular in respect to Sainfoin, because it may be sown with ſucceſs upon land of the most inferior value; and, if well attended to, will produce two tons of hay upon an acre, in a favourable season. At all events, it must not be stocked with any kind of cattle after Christmas, for they will destroy the bud for the next year. Hand manures seem the best for encouraging the growth of Sainfoin, as common dung has generally too many other graſs-seeds in it; and this plant will admit of no rival to come near it.

### 38. *On the Senecio Jacobæa, or Ragwort* *.

Few plants are more hurtful to pastures than the common Ragweed, which, if once established in a field, can hardly ever be entirely extirpated; and when it has once spread through a vast district of country, can scarcely be banished from a particular field: But nothing is more easy than to eradicate it entirely, when it first makes its appearance in any part of the country where it did not formerly abound, as I once experienced, in the following manner:

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* By James Anderson, L.L. D.

I once poſseſsed a farm in a part of the country where this plant did not abound; but some of the seeds of it had been brought by accident among the graſs-seeds, with which I sowed a field on that farm. The second year after sowing, that field was pastured, and it was very much over-run with rag-weed. I took care, however, to cause every plant of it to be cut down when it began to show its flower; and was attentive myself to observe, from time to time, that not one plant escaped: The consequence was, that next year only two or three plants appeared, in place of as many thousands the year before. Those few was carefully cut down, and the field, ever afterwards, was quite free of this destructive weed. It is obvious, however, that if it had greatly abounded in the adjoining fields, the same effects would not have resulted from this operation, as the seeds would have been blown from thence into my field. The rag-weed is a biennial plant; the seeds that are sown this season, only come into flower the next year, and if the plant be cut down when in flower, the root dies down during the ensuing winter, before it can produce any seeds.

### 32. *On the Sea-Worm* *.

This worm (Teredo Navalis) which is found so pernicious to the works of man, appears to have the same office allotted to it by the Author of Nature, as the Termites upon land; for was it not for the rapacity of the Sea-Worm, tropical rivers would be choaked up by the bodies of trees, which are constantly carried down by the rapid torrents. Wood, when immersed in deep water, is almost incorruptible; but when acted upon by those numerous animals, it is soon reduced into small particles, and, mixing, with the ocean, is thrown upon the shore, where the sun, air, and various insects, speedily bring about its entire diſsolution, in which state it becomes vegetable earth. This is part of the regular system by which the SUPREME BEING continues, directs, and governs the works of his creation; diſsolution and combination regularly following each other in endleſs succession.

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* By A. Hunter, M. D.

## 40. *On the effects of Smoke upon the Human Body, and its use in the Economy of Nature* *.

Various are the opinions of medical men upon this subject; some considering Smoke as prejudicial to the constitution, while others do not look upon it as unfriendly. In the year 1664, Mr. Evelyn wrote a treatise, intitled *Fumifugium*, recommending a method to prevent the bad effects of Smoke in the city of London. In that work he considers the great quantities of smoke, which, in large towns, daily ascend into the atmosphere, as likely to produce infectious diseases. On the contrary, others are of opinion, that these acid steams correct and neutralize the volatile alkali, which, in all large towns, arises in abundance from putrid substances; and which, if not corrected, would be productive of disease, by affording a putrefactive ferment to all living bodies under the influence of a putrid disposition. A physician of considerable eminence has embraced this opinion:

> Did not the acid vigour of the mine,
> Roll'd from so many thund'ring chimneys, tame
> The putrid steams that overswarm the sky;
> This caustic venom would perhaps corrode
> Those tender cells that draw the vital air,
> In vain with all their unctuous rills bedew'd.
>
> ARMSTRONG.

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* By A. Hunter, M. D.

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J: Halfpenny fecit.

In a medical light, the existence of Smoke may admit of controversy; but in a farming light, there can be no doubt of its utility; being one of the numerous agents that nature employs in the recovery of lands worn out by frequent and injudicious cropping.

### 41. *On the Tartarian Lamb* *.

This vegetable is called the Tartarian Lamb, from its resemblance in shape to that animal. It usually has four stalks that look like feet, and its body is covered with a brownish kind of down. Travellers report that it will suffer no vegetable to grow within a certain distance of its seat. Sir Hans Sloan read a memoir upon this plant before the Royal Society, and which is published in the 217th number of their Transactions. Mr. Bell, in his "Account of a Journey from St. Petersburgh to Ispahan," informs us, that he searched in vain for this plant in the neighbourhood of Astrachan, when, at the same time, the more sensible and experienced among the Tartars, treated the whole history as fabulous. This journey was undertaken in the year 1715. The annexed plate is taken from Mrs. Blackwell's Herbal, and seems a just representation of the plant. That given by Edwards has too much the appearance of fancy. It is the Polipodium *(Barometz)* frondibus bipinnatis: pinnis pinnatifidis lanceolatis serratis, radicibus lanatis, Linn. Dr. de la Croix, in correct and easy latin verse, has poetically described this supposed animal production, in a work entitled CONNUB. FLORUM.

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* By A. Hunter, M. D.

### 42. *On laying down Land with Graſs-Seeds* *.

The method pursued last year in laying my land down with Graſs-seeds, was attended with great succeſs. Instead of sowing my land with barley and seeds after turnips, as usual, after one ploughing, which was about the last week in April, I sowed half a peck of rape-seed mixed with one stone of Dutch clover, and one of trefoil. The rape got sufficiently high to shade the young plants from the sun. About the second week in July, I turned upon a ten acre field, one hundred and thirty wethers and ewes, part of which went fat to Rotherham market about the 11th of September, and the remainder I should have sent the latter end of the month, had not mutton fallen in price.

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* By Robert Lowe, Esq.

### 43. *On the Refuse of Whale-Blubber* *.

About thirty years ago, I recommended to the farmer a compost, of which the refuse of whale-blubber was the basis. Before that time, the persons employed in obtaining the oil, used to throw the refuse into the sea, as being the only method of destroying what, at that time, was considered as a body highly offensive. The improved state of agriculture has brought that once-neglected substance into repute; and, if my information be right, the boiling houses at Kingston-upon-Hull, annually dispose of 300 tons of whale refuse, at the following prices:

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|---|---|
| Grease, . . . . . . | 32s. per ton. |
| Finks, . . . . . . | 21s. |
| Gums, . . . . . . | 15s. |

The speculative farmer will find no difficulty in calculating the quantity of corn and graſs that the above three hundred tons will produce; and after he has satisfied himself on that head, he will next inquire into the quantity of beef, pork, beer, and biscuit, that the ships have consumed during their respective voyages, every particle of which we must consider as buried in the ocean—perhaps for the purpose of nourishing fuci, and other submarine plants. The balance, I apprehend, will turn out in favour of mankind.

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* By A. Hunter, M. D.

It is a pleasing reflection to find, that all nature is in motion, there not being a single particle of matter that is not employed in dissolution or combination, one body being constantly changed into another, so that nothing is, or can be lost, from the creation of the world to the present hour. A mind, harmonized to receive these truths, will contemplate this as the regular operation of that FIAT, which was given by the Almighty at the time when he thought proper to call forth this world into existence: And yet there are some men who foolishly contend, that this harmony is produced by the "fortuitous concourse of atoms."

### 44. *On a Disease fatal to Young Sheep in the month of October, with the Cure*[*].

In autumn, 1780, I went into the north of Devonſhire, to spend a few weeks with a gentleman who cultivated his own eſtate. In October, when the cold rains came on, for many days running, he had one or more young ſheep or lambs brought in, either dead or in a dying ſtate. They were one and all much ſwoln in the body, without any other viſible difference from thoſe that were well. In the field I obſerved they were much inclined to be ſtill, till rouſed and put up. I had ſeveral of them brought home and laid by the fire-ſide, and made ſeveral experiments upon them, but without ſucceſs. All the viſcera appeared to be ſound and perfect, and without the leaſt ſign of diſeaſe; only, as I ſaid, the body was greatly ſwoln.

When the knife entered the belly, there flew out a great quantity of rarefied air, with a conſiderable noiſe, upon which the body immediately fell to its natural dimenſions.—As no unſoundneſs appeared in any of the viſcera, I conceived that the expanſive vapour was probably the cauſe of the diſorder, and the effect of obstructed perspiration, occasioned by the cold rains so common at that season. Upon inquiry, I found the disorder was common in Devonshire at that season of the year, and at that time raged for many miles around, which confirmed my suspicion as to the cause of the disorder.

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[*] By Joſeph Wimpey, Eſq.

About sixty of these lambs remaining, I proposed to the hind, to try if we could preserve the remainder by sheltering them from the cold rains and damps of the night, by putting them into an airy barn, which was contiguous to the fields, to remain there till it might be thought proper to let them out in the morning. This effectually answered the purpose, for not one miscarried afterwards. In three or four days time, their coats which appeared of a washed sickly white while they lay out, became a natural healthy looking yellow, and they appeared as lively and healthy as at any time of the year. I should therefore, hope, if this method be pursued, many thousands may be preserved by its means.

Were I a farmer poſseſsed of a considerable flock, I would certainly erect a proper building for the purpose. It might be done at a small expense, and a great quantity of manure got from it, especially if the floor was covered with an absorbent earth, or sand with straw over it. By this means all the urine and dung might be saved, which would be a great acquisition; as for the most part it is dropped under hedges, or upon the surface of the land, where the sun and wind readily exhale its fertilizing juices, with little or no benefit to the soil.

Such a building would be as salutary a defence against the scorching heats of the summer, as against the unhealthly and stagnating rains of the winter. In deep snows it would be a very proper place to fodder in, and salt-licks might be provided under its cover for the sheep at all times to resort to. In Spain these salt-licks are common, and the cattle resort to them either through instinct, or from having contracted, by example and habit, a liking to salt.

Such a building would also be very useful for large cattle, with an opening on the most sheltered side, large enough for two to run in a-breast. It might be thatched and wattled on the sides and ends, which would be warm enough, the cattle being left at liberty to go in and out at pleasure; by which means they would equally avoid the violent heat and hasty storms of summer, and the soaking rains and chilling blasts of winter. This method is, perhaps, the very best for keeping cattle healthly which are in constant work, and of collecting a very large quantity of manure, on or near the spot where it is to be used. For the dung and urine which is left under the hedges, or in the field promiscuously, is of very little use in improving the soil.

### 45. *To prevent the Putrefaction of Meat recently Killed**.

To preserve meat from putrefaction till it is cold, whether ox, cow, sheep, or pig, let the animals be kept fasting for twenty-four hours. Kill them in the evening, and as soon as the skin is taken off, hang the carcaſs between two door-ways where there is a current of air. Then get a fan, such as is used for winnowing corn, and place it to windward of the carcaſs, and let a man turn the fan during the whole night. In the morning the carcaſs will be cold and stiff, let the weather be ever so hot. A putrefaction will not immediately follow the slaughtering of the animal, because the fluids are at rest. Carcaſs butchers, and people who kill for the navy, would find their account in having slaughter-houses near to a rivulet of water, where a wheel might be placed to turn a fan and many carcaſses hung up for the benefit of the wind. By this method, a considerable quantity of lost meat might be annually saved; for in hot sultry weather, when no wind is stirring, meat will taint before it is cold. Medical men may find this an useful hint for removing the putrid air from the chambers of persons labouring under contagious diseases.

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* By Mr. J. Smith.

### 46. *A new method of laying down Land**.

A gentleman in the East-Riding of the County of York, obtains an excellent pasture, by sowing white clover and trefoil with a crop of buck-wheat. The buck-wheat being sown about Midsummer, gives time to have the land well cleaned, andthe openneſs of the plant at bottom allows the seeds to vegetate with freedom. Farmers who lay down their lands with hay-seeds, should be very circumspect in examining those that they purchase, for if weeds are sown, weeds will grow. To be a judge of hay-seeds, the farmer should collect a few seeds of all the noxious weeds that infest meadows and pastures, and after he has habituated his eye to their shape, size, and colour, he will have no difficulty in instantly judging of the sample shown him by the seedsman.

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* By A. Hunter, M. D.

### 47. *A mode of Curing Clover-hay**.

This mode, which is called *tipling*, is thus practised: The men and women employed, soon after the clover is cut down, and a little dried, take up in their hands a sufficient quantity to form a loose sheaf, in the shape of a cone, whose base may be about ten inches, and its height eighteen inches: they bind it about the middle with a few long stalks; and from the top another string of clover is drawn out with the finger and thumb to bind it at the top. These sheaves are then set in rows, in regular order, and remain till sufficiently dry to take into the barn or stack. If the weather proves very wet, the lines of the sheaves are occaſionally removed; and before they are taken in, are laid on one ſide, to let the air paſs through them. By this mode, all the leaves and flowers of the plant are preſerved, and not left in the field, according to the old method. Mr. Wakefield, on his reclaimed bog at Trafford, thus cured and carried into his ſtacks a very great quantity of clover-hay, in September and October laſt, after ſome weeks heavy rain, and it turned out to be the beſt clover-hay ever known in the country; and his practice is now ſucceſsfully followed by others in his neighbourhood. I both ſaw the proceſs, and the hay after curing, and teſtify to the accuracy of the fact. Colonel Macdowal, commanding the Prince of Wales's regiment of cavalry, in the barracks at Mancheſter, purchaſed conſiderable quantities of this hay for the horſes of the regiment, and ſays he never ſaw better. The expenſe of *tipling* did not exceed five ſhillings a ſtatute acre; and it may be done for leſs.

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* By T. B. Bailey, Esq.

So much clover-hay has, in the old way, been ſpoiled in Lancaſhire, that many farmers were backward in ſowing it for the purpoſe of hay; but ſince this practice has been known, they have no longer any apprehensions. I have seen these sheaves sustain a month's rain; and yet, on examining the hay out of the stack, found it has fine as any I have ever met with.

### 48. *On Night Soil* *.

It has often struck me with wonder that the excrements of horses and cattle are almost alone preserved for manuring land, and that human excrement, which is infinitely richer, is so much neglected; many privies being so constructed, that either the whole is lost in common sewers, or the most enriching part of it, the salts, contained chiefly in the urine, sunk in the ground, or running to waste. We ought to learn from the Chinese how to preserve those precious relics of our digestions, and to restore them to the soil, on purpose to be metamorphosed by it into new food. I make no doubt that if none of a man's ejections were dissipated, but employed in due time on the soil which was allowed him to draw exclusively his victuals from, this soil would be so much fertilized by it, as to afford, by proper labour, more than sufficient food to nourish him. The alvine, and urinous ejections of one day, kept together and well mixed, are more than sufficient to dung abundantly, for a whole season, four square feet of ground. Now on a space of four square feet, there will grow more potatoes, or other vegetables, than a man can well consume in one day. By selling some of this superfluous product, he may purchase what is neceſsary to make his potatoes, or food exchanged for them, palatable. The Chinese neglect the dung of horses and cattle; but they provide every where covered reservoirs for storing up what we uſeleſsly leave in our privies. The common sewers of all large towns convey into rivers our richest excrementitious matters, which, if retained, would prove of great public utility.

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* By John Ingenhousz, M. D.

### 49. *On Aſses*[*].

The Earl of Egremont, early in 1800, established a team of six Jack-aſses for carting, and has found them during nine, or ten months, extremely useful. Six of them bring a chalton and quarter of coals, twice a day, in a waggon from the canal to his Lordship's house at Petworth, which shows a degree of strength not expected in them. They are gentle, docile, and perfectly handy. In the winter months they had no oats, nor any other hay than the bands of the truſses consumed by horses, but lived on furze and holly; they are hardy, and kept for a trifle. This experiment deserves much attention, for I suspect that aſses will be found by far the cheapest team that can be used.

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[*] By A. Young, Esq.

### 50. *On feeding Wheat with Sheep**.

This is a practice that ought not to be generally adopted, even where the crop is rank, or, as we term it, *winter-proud;* because in many cases, it would not answer any good purpose, but, on the contrary, injure the crop. In some instances, however, it has succeeded, and the advantages are these It affords food for ewes and wethers, when turnips are over, and before the spring feed comes in; it causes the wheat to branch out into a greater number of stalks than it would otherwise have done, and, of course, the crop will be increased: By the warmth of the sheep when lying on it, and the manure they leave, the crop is brought forwarder, and the ears made heavier. In light lands especially, the treading of the sheep fixes the earth about the roots of the corn, which causes the ground to retain its moisture longer in a dry spring.

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* By a Gentleman Farmer in Eſſex.

On the other hand, this practice is liable to the following disadvantages:—In some lands it checks the growth of the corn, and occasions the second shoots to be weak and small: of course the ears will be small, and the grain light in proportion; in foul lands and a wet season, it gives opportunity for the weeds to rise above the corn, so as to choak it. Sheep are also apt to bite off the knot of the plant, to prevent which, the farmer should turn the sheep in hungry, and take them out as soon as they have filled their bellies. When hungry, they will eat the leaves of the plant, but when their hunger is satisfied, they will pick out the knot or crown of the plant, that being the most sweet and delicate part.

This practice answers best on clean land and a light soil. Here the treading of the sheep is of service; and there is no danger of weeds rising so as to injure the crop.

In September, 1777, I sowed fourteen acres of wheat, which, soon after Christmas, seemed *winter-proud*. The soil was a loose loam, and I had laid on plenty of dung. In the beginning of February, I turned about sixty sheep into the field, and fed it down; but the weather coming in milder than I expected, the weeds produced by the dung, got so much a head of the wheat, that the crop only produced nineteen bushels per acre.

I had another field of wheat, which was very poor land, but being a turnip fallow, was clean, and had not been manured. In February, I observed the plants to be small, and to stand thin upon the ground, which induced me to turn in sheep, thinking it would cause the plants to throw out more side-stems. The crown not being much above ground, there was no danger of its being eaten off. The experiment succeeded, and I reaped near four quarters per acre.

From the closest observation I find, that wheat ought not to be fed down with sheep, unleſs it be very rank in January; and that such lands only should be fed as were sown early, being neither rich with dung, nor weedy.

After being fed, if the land be clean, a top-dreſsing of soot, ashes, malt-dust, &c. will greatly cherish the crop. This I have experienced in many instances, and can safely recommend the practice.

### 51. *On the Time of sowing Wheat**.

The mildew had made such havock for several years with much wheat in my neighbourhood, that I was induced to be very attentive to the circumstances that seemed to have any reference to that distemper: among others, none appeared to be so interesting as EARLY SOWING; it would be tedious to mention every instance in which it had been favourable. With this inducement, I sowed an eight-acre field, of a sound, friable, sandy loam, the beginning of September, finishing the 15th; it came up very luxuriantly, and was almost as green as a meadow before any other field in the country was sown. It came up in eight and nine days; the autumn proved remarkably dry. November 9, I find a memorandum in my pocket-book, that the ponds and wells were never so low in the memory of man. It was the 11th before any rain fell; and all my neighbours were sowing their wheat the end of November, or beginning of December. In the spring and summer, my wheat flourished remarkably, while seven-eights of the crops around had a miserable appearance, and some parts of fields were actually ploughed up. In the present harvest, this field was ready to cut three weeks before any other, and a month before many. I began to reap it July 28, and the 14th of August I carted the whole to the stack, that is before many of my neighbours had begun their harvest. This earlineſs of harvest will, upon an average of years, be a great advantage, for reasons too obvious to mention. In respect to the mildew, it totally escaped; yet several fields near mine were considerably attacked, and one, (late sown,) quite black with it. Here then is a fresh reason for sowing early. My crop, though extraordinary for the season, is not large, which was owing to its being sown too thick. I sowed two bushels and a peck per acre, but so early in the season, one bushel and a half would have been sufficient. In former experiments, the thickest places escaped the mildew best, which was my motive for using so much seed. I had this year twelve other acres sown thinner in September, which are a very capital crop, and quite bright, and clear from mildew, except some few spots: that is also quite ripe, and now reaping, August 15. To proſecute further this inquiry into the time of sowing, I shall begin this year earlier.

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* By A. Young, Esq.

### 52. *To destroy the common Thistle*[*].

The best way to destroy the common Thistle in pasture grounds, is to mow it when going into bloſsom, leaving the stems about four inches high. Then introduce a large and heavy wooden roller, so as effectually to bruise the stalks. This should paſs four times in one place, and twice acroſs. I give this upon respectable authority.

### 53. *On Work on Sundays, during Harvest*[†].

A gentleman of the strictest moral character, and who lives in the county of Norfolk, is known to practiſe the following management. His men go to church in the morning, and then immediately to the field, where their uſeful and honeſt induſtry will, I truſt, be as acceptable in the ſight of God, as the more common diſſipation in an ale-houſe. I could ſhow, by a very plain calculation, that a day's huſbandry-labour in England amounts, in the pay only, to near 50,000l. Suppoſe harveſt to laſt ſix weeks, as it does upon an average, ſix Sundays amount to near 300,000l. a year; but as they would not work the whole day, let us ſuppoſe it only 200,000l. We are then to take into account the effect of that labour upon the conſiderable value which paſſes under it in corn and hay harveſt; together with the difference between corn carted on a dry Sunday or a wet Monday. A man whoſe pay is three or four ſhillings, will (in union with his fellows, and the aſſiſtance of horſes,) convey from the field to the barn two acres of corn, which may be worth ten pounds. Upon ſuch a value, it is not extravagant to ſay, that we ought, in the national account, to treble the pay of the man, and aſſert, that ſix Sundays, after morning ſervice, are worth in the kingdom 600,000l. a year. I leave it to all conſiderate men to form the enlarged comparison of national advantage and good morals on one hand, with the common practice on the other.

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[*] By A. Hunter, M. D.

[†] By A. Young, Esq.

### 54. *On Butterwort, or Yorkshire San*

If the fresh-gathered leaves of this plant be put into a strainer through which warm milk is poured, and the milk be set by for a day or two to become acescent, it acquires a consistency; the whey does not separate, nor does the cream rise. In this state it is an extremely grateful food, and used as such by the inhabitants of Sweden. Half a spoonful of this prepared milk, mixed with fresh warm milk, will convert it to its own nature; and this again will change another quantity of fresh milk, *ad infinitum.*

### 55. *On steeping Seed Barley in a dry Season*†.

The last spring being remarkable dry, I soaked my seed barley in the black water taken from a reservoir which constantly receives the draining of my dunghill and stables. As the light corn floated on the top, I skimmed it off, and let the rest stand twenty-four hours. On taking from the water, I mixed the seed grain with a sufficient quantity of sifted wood ashes, to make it spread regularly, and sowed three fields with it. I began sowing the 16th, and finished the 23d of April. The produce was sixty bushels per acre, of good clean barley, without any small or green corn, or weeds at harvest.

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* By Mr. A. Crocker.

† By Mr. James Chapple.

I sowed also several other fields with the same seed dry, and without any preparation; but the crop, like those of my neighbours, was very poor, being not more than twenty bushels per acre, and much mixed with green corn and weeds when harvested. I also sowed some of the seed dry on one ridge in each of my former fields, but the produce was poor in comparison with the other part of the field.

### 56. *On the Paliurus, or Christ's Thorn* *.

The Paliurus is supposed to be the plant that composed the crown that was placed upon the head of Christ at his Crucifixion; but Dr. Haſselquist, who had great opportunities of examining the plants of the Holy Land, is of opinion that it was a species of Zizyphus which grows in great plenty in the neighbourhood of Jerusalem. It is a very thorny plant, and is called by Linnæus, *Rhamnus aculeis, geminatis rectis, foliis ovatis.* Sp. Pl. 282. The learned Dr. Pearce, late Lord Bishop of Rochester, sees the whole of this transaction in a very different light. And as his own words will best explain his opinion, I shall here transcribe them from his most excellent work entitled, 'A Commentary " upon the Four Evangelists.' "The ακανθων " may as well be the plural genitive case of " the word ακανθως as of ακανθη: If of the latter, " it is rightly translated *of Thorns*, but the for- " mer word signifies what we call *Bears-foot*, " and the French *Branche Ursine.* This is " not of the thorny kind of plants, but is soft " and smooth. Virgil calls it *Mollis Acanthus* " (Ecl. iii. 45, and Georg. iv. 137): So does " Pliny, Sec. Epist. v. 6. and Pliny the elder, " in his Nat. Hist. xxii. 22. (p. 277. Edit. " Hard. fol.) says that it is *lævis*, smooth, and " and that it is one of those plants which are " cultivated in gardens. I have somewhere " read (but cannot at present recollect where,) " that this soft and smooth herb was very

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* By A. Hunter, M. D.

" common in and about Jerusalem. I find " nothing in the New Testament said concerning this crown which Pilate's soldiers put " upon the head of Jesus, to incline one to " think it was made of thorns, and intended " (as is usually supposed) to put him to pain. " The reed put into his hand, and the scarlet " robe on his back, were only meant as marks " of mockery and contempt. One may also " reasonably judge by the soldiers being said " to plait this crown, that it was not composed " of such twigs and leaves as were of a *thorny* " nature. I do not find that *it* is mentioned " by any one of the primitive Christian writers, " as an instance of the cruelty used towards " our Saviour before he was led to his crucifixion, till the time of Tertullian, who lived " after Jesus's death at the distance of above " one hundred and sixty years. He indeed " seems to have understood ακανθων in the sense " *of thorns*, and says, De coron. milit. Sect. xiv. " (Edit. Pomel. Franck. 1597.) *quale, oro te,* " *Jesus Christus sertum pro utraque sexu subiit?* " *De spinis, opinor, et tribulis.* The total " silence of Polycarp, Barnabas, Clem. Romanus, and all the other Christian writers, " whose works are now extant, and who " wrote before Tertullian, in this particular, "will give some weight to incline one to "think that this crown was not plaited with "*thorns*."—Vol. 1. p. 196. Ed. 1777.

### 51. *On the common Furze, or Whin**.

Mr. Evelyn very warmly recommends this shrub not only for hedges, but for fodder to cattle in winter. In his days it seems to have been a favourite plant for those uses.—Mons. Duhamel, in his Elements of Agriculture, speaks much in its favour as winter provender for cattle. "In Normandy and Bretagne, at "the beginning of winter, when the graſs "fails, they cut the young shoots of this plant to "supply the place of fodder; the first cut-"ting is in December; but in good soils it "shoots again, and may be continued cutting "without permitting it to bloſsom, because "the prickles are then tender; and a few "strokes of the mallet are sufficient to pre-"pare it as food for horses or other cattle, "which derive good nourishment from it. In "countries where they have mills to grind "apples, or seeds from which oils are ex-"preſsed, these serve to grind the furze with

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* By A. Hunter, M. D.

"great expedition." Vol. ii. p. 124. From a Memoir inserted in the fourth volume of the "Present State of Husbandry in Scotland," it appears that in the county of Aberdeen, they make use of bruised whins for winter fodder, and find them to answer well both for horses and oxen.

## 5[illegible]. *On the Culture of Buck-Wheat; Wheat, and Potatoes, alternately; and the uses of Buck-Wheat*[*].

It was in 1780 that I began this culture. About seven acres of a sandy soil on Brislington common[†], having been first tolerably well cleansed from brambles, furze, &c. received one ploughing. To reduce the irregularities of the surface, it was rolled; and on the 9th of June, in that year, two bushels and a half of buck-wheat per acre sown, the ground rolled again without harrowing.

The vegetation appeared in five or six days, as is constanly the case be the weather wet or dry. The growth was so rapid, that the fern with which this land greatly abounded, was completely kept under. About the middle of September the crop was mown, but, by reaſon of a great deal of rain about that time, it was not secured until the beginning of October; hence a loſs of great part of the grain by shedding, as well as some eaten by birds. However, there were ſaved about twenty-four Winchester bushels per acre, which, notwithstanding its long exposure to the weather, received no sort of damage, only perhaps, that the finest and most perfect grain was the first to fall from the plant. The ground after this had almost the appearance of a fallow, and was immediately ploughed.

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[*] By Nehemiah Bartley.

[†] A very rough piece of land, at that time just inclosed.

When it had lain a moderate time to meliorate, and to receive the influences of the atmosphere, it was harrowed, sown with Lammas wheat, and ploughed in under furrow, in a contrary direction to the first ploughing. Thus a piece of land, which in the month of April was altogether in a state of nature, in the following November was seen under a promising crop of wheat, and this without the aid of manure, or of any very great degree of tillage. Nor was the harvest by any means deficient; for several persons, conversant in such things, estimated the produce from twenty-six to thirty bushels per acre; I had not then the precaution to register the exact measure. As soon as the wheat crop was taken off, the ground had one ploughing, and on the 1st of September following was sown with turnip-seed. The turnips were not large; but of an herbage so abundant, as in the following spring to support one hundred and twenty ewes with their lambs, which were fed on it by folding four weeks. After this it was manured with a composition of rotten dung and natural earth, about twenty putt loads per acre, and planted with potatoes. The crop sold for one hundred and thirty-eight pounds, besides a considerable number used in the family, and a quantity reserved, with which ten acres were planted the following season. The ensuing autumn it was again sown with wheat, and produced an excellent crop. In the spring of 1784, it was manured and planted with potatoes, as in the preceding instance; the crop (though tolerably good) by no means equal to the former, producing about one hundred sacks per acre only.

This land is now, for a third time, under a crop of wheat, it being my intention to try how far this mode of alternate cropping, one year with potatoes, and another with wheat, may be carried.

From the succeſs of the preceding experiment on buck-wheat, it is become with me a favourite object of cultivation; being clearly of opinion, that it ought in numerous cases to supersede the practice of summer fallowing; for the crop produced seems not only to be so much clear gain in respect to such practice, but also affords a considerable quantity of straw for fodder and manure; beside that, I think a summer fallowing is nothing like so advantageous a preparation for a succeeding crop as buck-wheat. From its quick and luxuriant vegetation, it is an admirable destroyer of weeds, and suits with a dry, light, mellow soil, but flourishes most in a light sand. It is impatient of wet and cold.

The proper season for sowing, I take to be from the middle of May to the middle of June. I have sown it, however, so early as the beginning of April, and so late as the 22d of July, by way of experiment, but have found the latter extreme rather to be chosen.

The use to which I have hitherto applied buck-wheat, hath been mostly in feeding hogs, for which I esteem it equal in value to barley; it is much more easily and conveniently ground than barley, as a malt-mill will grind it completely. Horses are very fond of the grain, and poultry of all sorts are speedily fattened by it. Probably it may hereafter be found a material article in distillation, should a sufficient quantity be raised with that view. After spring feeding a crop of cole-seed, turnip-rooted cabbage, or vetches, there will be sufficient time to sow the land with buck-wheat. Probably a crop of vetches might be mown for hay early enough to produce a crop of this grain after it.

### 59. *On making Compost Dunghills with Peat-Moſs*[*].

Let the peat-moſs, of which compost is to be formed, be thrown out of the pit for some weeks or months, in order to lose its redundant moisture. By this means, it is rendered the lighter to carry, and leſs compact and weighty, when made up with fresh dung for fermentation; and, accordingly, leſs dung is required for the purpose, than if the preparation is made with peat taken recently from the pit. The peat taken from near the surface, or at a considerable depth, answers equally well.

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[*] By Lord Meadowbank.

Take the peat-moſs to a dry spot, convenient for constructing a dunghill to serve the field to be manured. Lay the cart-loads of it in two rows, and of the dung, in a row betwixt them. The dung thus lies nearly on an area of the future compost dunghill, and the rows of peat should be near enough each other, that the workmen, in making up the compost, may be able to throw them together by the spade. In making up, let the workmen begin at one end; and at the extremity of the row of dung, (which should not extend quite so far at that end as the rows of peats on each side of it do,) let them lay a bottom of peat, six inches deep, and fifteen feet wide, if the grounds admit of it; then throw forward, and lay on about ten inches of dung above the bottom of peat; then add from the side-rows about six inches of peat; then four or five of dung, and then six more of peat; then another thin layer of dung; and then cover it over with peat at the end where it was begun, at the two sides, and above. The compost should not be raised above four feet, or four feet and a half high; otherwise it is apt to preſs too heavily on the under parts, and check the fermentation. When a beginning is thus made, the workmen will proceed working backwards, and adding to the column of compost, as they are furnished with the three rows of materials directed to be laid down for them. They must take care not to tread on the compost, or render it too compact; and, of consequence, in proportion as the peat is wet, it should be made up in lumps, and not much broken.

In mild weather, seven cart-loads of common farm-dung, tolerably fresh made, is sufficient for twenty-one cart-loads of peat-moſs; but in cold weather, a larger proportion of dung is desirable. To every twenty-eight carts of the compost, when made up, it is of use to throw on, above it, a cart-load of ashes, either made from coal, peat, or wood; or, if these cannot be had, half the quantity of slacked lime may be used; the more finely powdered the better. But these additions are nowise eſsential to the general succeſs of the compost.

The dung to be used should either have been recently made, or kept fresh by compreſsion; as, by the treading of cattle or swine, or by carts paſsing over it. And if there is little or no litter in it, a smaller quantity will serve, provided any spungy vegetable matter is added at making up the compost, as fresh weeds, the rubbish of a stack-yard, potatoe-haulm, saw-dust, &c. And as some sorts of dung, even when fresh, are much more advanced in decomposition than others, it is material to attend to this; for a much leſs proportion of such dung as is leſs advanced, will serve for the compost, provided care is taken to keep the maſs sufficiently open, either by a mixture of the above-mentioned substances, or, if these are wanting, by adding the peat piece-meal; that is, first making it up in the usual proportion of three to one of dung; and then, after a time, adding an equal quantity, more or leſs, of moſs. The dung of this character, of greatest quantity, is shambles dung, with which, under the above precautions, six times the quantity of peat, or more, may be prepared. The same holds as to pigeon dung, and other fowl dung; and, to a certain extent also, as to that which is collected from towns, and made by animals that feed on grains, refuse of distilleries, &c.

The compost, after it is made up, gets into a general heat, sooner or later, according to the weather, and the condition of the dung: In summer, in ten days or sooner; in winter, not perhaps for many weeks, if the cold is severe. It always, however, has been found to come on at last*; and, in summer, it sometimes rises so high as to be mischievous, by consuming the materials (fire-fanging). In that season, a stick should be kept in it in different parts, to pull out and feel now and then; for, if it approaches to blood-heat, it should either be watered, or turned over; and, on such an occasion, advantage may be taken to mix it with a little fresh moſs†. The heat subsides after a time, and with great variety, according to the weather, the dung, and the perfection of the making up of the compost, which then should be allowed to remain untouched, till within three weeks of using, when it should be turned over, upside down, and outside in, and all lumps broken: Then it comes into a second heat, but soon cools, and should be taken out for use. In this state, the whole, except bits of the old decayed wood, appears a black free maſs, and spreads like garden mould. Use it, weight for weight, as farm-yard dung; and it will be found, in a course of cropping, fully to stand the comparison.

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* In order to bring on the heat more expeditiously, in a compost made up in frost, a narrow addition of dung and peat has, sometimes, after the frost had gone off, been laid along the sides of the compost, scraping down a little the coating of peat upon it.

† In June, 1796, a compost was formed, only 2½ peat to 1 dung: It heated in July beyond the measure of a thermometer graduated to 110°. Part was allowed to stand, part turned with a half more moſs. Three weeks after, (18th August,) the heat of the former had descended to 84°, while that of the latter had got up again to above 110°.

Let it be observed, that the object in making up the compost, is to form as large a hot-bed as the quantity of dung employed admits of, and then to surround it on all sides, so as to have the whole benefit of the heat and effluvia. Peat, nearly as dry as garden-mould in seed-time, may be mixed with the dung, so as to double the volume and more of it. Workmen must begin with using layers; but, when accustomed to the just proportions, if they are furnished with peat moderately dry, and dung not lost in litter, they throw it up together, as a mixed maſs; and they improve in the art, so as to make a leſs proportion of dung serve for the preparation.

The addition recommended, of ashes or lime to the compost, is thought to favour the general perfection of the preparation, and to hasten the second heat. The lime laid on above the dung-hill, as directed, is rendered mild by the vapours that escape during the first heat.

Compost, made up before January, has hitherto been in good order for the spring crops; but this may not happen in a long frost. In summer, it is ready in eight or ten weeks; and if there is an anxiety to have it soon prepared, the addition of ashes, or of a little lime-rubbish of old buildings, or of lime slacked with foul water, applied to the dung used in making up, will quicken the proceſs considerably.

Lime has been mixed previously with the peat; but the compost prepared with the mixture, or with the simple peat, seemed to produce equally good crops. All the land, however, that it has been tried on, has been limed, more or leſs, within these twenty-five years.

The rich coarse earth, which is frequently found on the surface of peat, is too heavy to be admitted into this compost; but it makes an excellent top-dreſsing, if previously mixed and turned over with lime.

Peat, prepared with lime alone, has not been found to answer as a good manure. In one instance, viz. on a small piece of fallow, sown with wheat, it was manifestly pernicious.

### 60. *On middle Men*[*].

If the farmer was obliged to sell all the corn he brought to market to the consumer, and if the consumer could only purchase of the farmer, what would be the consequence? In an overstocked market, the farmer must be ruined; and in an ill-supplied market, the consumer must starve. Hence arises the neceſsity of the employment of the capital of the *middle man*, who, by affording the farmer a certain sale, enables him to sell cheaper; and who, because he purchases more than he consumes, has the means of furnishing the market with whatever the demand may require. No large

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[*] By A. Young, Esq.

city could be adequately supplied without the intervention of those middle men, who have lately been represented as interfering without neceſsity, and have been treated, by a misguided multitude, as objects of public odium and detestation.

### 61. *On folding Sheep* *.

Three thousand two hundred South Down sheep will fold one English acre per night. The manure may be valued at from 35 to 50s. per acre, the goodneſs of which depends much on how the sheep are kept; if kept on artificial food, such as tares, rape, clover, turnips, &c. they will drop more soil than if fed on graſs only. Suppose we estimate the folding at 40s. per acre, it will amount per annum to 4s. 6¾d. per sheep; 22l. 16s. 3d. per hundred; or, per thousand, 223l. 2s. 6d. This calculation is made on the supposition that the sheep are folded through the year. If it be a breeding stock, it might be well to omit folding for five or six weeks immediately after lambing, as the young lambs might suffer from being trampled upon; and, from driving to and from the fold, they would often lose their dams, and suffer in that way more than if they remained quiet.

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* By A. Young, Esq.

### 62. *On the Gooseberry Caterpillar*[*].

The moths, (*Phalænæ Groſsulariatæ* of Linnæus,) from which the Gooseberry and Currant Caterpillars (which are the same,) are bred, are small, having yellow bodies, with many black spots, and their wings white, with yellow streaks spotted with black. They appear in the month of July, in the evenings, and ought to be attentively killed by all attentive gardeners. They seldom fly far from the bushes on which they deposit their eggs. They live about twenty days, during which time they (for many of the moth tribe have not even mouths,) eat little. The eggs, which are yellow, are glued below the clefts, and under the larger arms near the bottom, and sometimes on the leaves of the bushes that are proper for serving the young progeny for food. One moth produces upwards of one hundred and fifty eggs. The young worms generally appear in spring, but they are frequently hatched in autumn. I have observed the young, in great numbers, devouring the leaves of the gooseberry-bush as early as the 15th of August, that is, about three weeks after the eggs are laid. They sometimes eat up the embryo of the new leaves and flowers of the bush in October, which renders any hope of fruit, for the ensuing year, abortive. Neither the frost nor snow of winter destroys them. I have taken particular notice of some of these caterpillars remaining on a currant-bush without being affected by cold or hunger, from November to March. During winter, and the early part of spring, they lurk in clusters below the clefts, and then is the time that they ought to be crushed.

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[*] By Mr. J. Brown.

# ESSAY XI.

## *Observations upon certain Fungi, which are Parasites of the Wheat.*

During the time that my attention has been directed to those insects which frequent the wheat fields, I have often had occasion to observe the appearance produced in that grain by several different species of Fungi*, which derive their nourishment from it. I thought of considering this subject at large, but as my time is likely to be fully employed in other pursuits, I see no probability of doing this in the manner that I could wish; and, therefore, having made some observations, which, though by no means complete, may not be wholly unimportant, I now beg leave to lay them before the public, trusting that they may serve as hints to others who may be inclined to enter more fully upon so interesting a subject.

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* That these appearances are produced by minute vegetables of the order of Fungi, seems now to be acknowledged by those naturalists who are the most conversant with that order.

I have noticed five or six different species of these Fungi. The first I shall mention is named by Dr. Withering, Reticularia segetum[*]. In the Rev. Henry Bryant's pamphlet upon Brand[†], it is called Dust Brand[‡]. Here its usual name is Smut, or Burnt Corn. This species is common to wheat, oats, barley, and rye. I have also seen the festuca fluitans, and some other graſses affected by it. It is scentleſs, and consumes not only the farinaceous part of the grain, but even the arillus and chaff, dispersing itself entirely before the corn is cut; so that the injury which it occasions is confined to the quantity of grain destroyed by it, which is not very great in any season. I have seen, more than once, half an ear of corn affected by this Fungus, when the other half was sound and good. Sometimes it injures all the stems that spring from the same root;

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[*] Bot. Arr. vol. 4. p. 388.

[†] A particular inquiry into the causes of that disease in Wheat commonly called Brand, &c. Norwich, 1783.

[‡] Bryant, p. 31. 54.—56.

at other times part of them escape: I never could discover any diseased appearance about the root. The ear is often affected by this reticularia before it emerges from the folium vaginans, or hose.

Barley and oats are more frequently attacked by it than wheat; but this may be accounted for, by the latter being usually dreſsed for sowing. Mr. Lathbury examined the dust of this Fungus under a powerful magnifier, and found that it consisted of a number of minute particles, uniform in shape and size, much smaller and blacker than those of the Pepper Brand, and leſs easily separable; they seemed to be contained in little irregular cells. This dust, or seed, is the food of a small, shining, black Dermestes*.

The next species that I shall mention, is what Mr. Bryant distinguishes by the name of Pepper Brand †: with our farmers it is simply called Brand or Bladders. This species does not eat through the arillus, consuming only the farinaceous part of the grain. The ears affected by it are easily discovered by their external aspect; for the chaff opens, as if unnaturally distended *, the germen becomes shorter and rounder, and exhibits the appearance both of swelling and (if it may be allowable to apply such a term to it) inflammation; for instead of the pale pleasant green which is the colour of this grain in a healthy state, it aſsumes one of a deep and dingy hue: in this state it easily breaks when rubbed; and the sooty powder that soils the fingers, emits a very fetid scent, extremely similar to that of putrid fish, or chenopodium vulvaria. These circumstances sufficiently distinguish it from reticularia segetum, and render it, when at all plentiful, exceedingly prejudicial to the farmer; for, as it does not eat its way through the arillus, and disperse itself before the corn is cut, it is carried with it into the barn, and, being broken under the flail, when the wheat is threshed, discolours and otherwise injures the sample, to such a degree as to render it unsaleable, or at least greatly to reduce its price. To prevent this evil, farmers generally dreſs their seed-wheat with various prepara-

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* Dermestes ater Marsham.

† Bryant, p. 32.

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* Bryant, p. 43.

tions: some use a lixivium of wood-ashes and urine; others, salt and water only, or sea-water, if at hand; others, the lye from the soap-boilers; others again, urine and cheese-whey; and I have heard of some who have infused arsenic for this purpose. All, I believe, dry their seed with fresh slaked slime. This custom, which is nearly universal, at least in these eastern counties, proves the idea to be general, that the disorder originates from the adhesion of the dust or seed of the Brand to the seed of the wheat, and that by these methods it is either washed off or destroyed: but what kind of substance it is, whether animal, vegetable, or merely a distemper incident to this grain, agriculturists do not trouble themselves much to inquire: this, indeed, is properly the busineſs of the naturalist; and of these latter, the opinions concerning it are various. Mr. Bryant, in the pamphlet referred to above, is strenuous for its being occasioned by an injury which he supposes the antheræ receive, by too great constriction, when the ear emerges from the folium vaginans *; and therefore he scouts the common practice, just

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* Bryant, page 50—53.

mentioned, of dreſsing the seed, as answering no good end, and destructive of the grain *. Some take the dust for the eggs of insects, and others adopt, what to me appears the most probable opinion, that this evil is occasioned by a minute vegetable of the order of Fungi.

Mr. Bryant founds his hypothesis upon few experiments, and those not very precisely stated †: the one was favourable rather than otherwise to the practice which he is endeavouring to set aside ‡. This was made upon a small scale in his garden. From his larger experiment, no fair consequences in support of either side of the question can be drawn ; for it was made in two separate fields, the corn being sown unprepared in one, and dreſsed as uſual in the other ||. Whether these

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* In justice to this gentleman, I must acknowledge, that, with respect to this circumstance, his opinion seems founded upon fact ; for I am informed by intelligent farmers, that much of the grain does perish, as they suspect by the use of lime. But is the evil incurred, greater than the evil prevented ?

† Bryant, p. 24, 25.

‡ Id. p. 32, 33.

|| Id. p. 24, 25.

fields were near to each other, or far asunder, or of a similar or different soil, he does not inform us. The result of this experiment was rather in favour (not much he confeſses *) of the undreſsed seed. Now, as some years are much more favourable to the production of Brand, it is probable, than others †; and it is not to be expected that any precaution should so infallibly secure our crops as that they shall never be injured, no sound reasoner would venture to build a system upon experiments, much more numerous and decisive than those related by Mr. Bryant, which were made in a single year. Again, as some soils may be more given to the production of this disease, or whatever we are to call it, than others, nothing satisfactory can be deduced from such experiments, as are tried in different fields, where the soil, aspect, or mode of cultivation, and management, might be different. Mr. Bryant's method of accounting for this

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* Id. p. 33.

† A tenant of mine in the year 1797, I think, told me that his wheat that year was very much injured by the Brand, although he prepared it in the same manner as he had done for ten years before, and always till then with succeſs.

disorder is certainly ingenious, but founded upon no arguments which can convince one who is in search not of theories but of truth. That the practice of dreſsing the seed previous to sowing, in the way above-mentioned, is a very effectual preventive of the Brand, will appear sufficiently evident, when I proceed to lay before the public the result of some experiments made by my ingenious and accurate friend the Rev. Peter Lathbury, F. L. S. Upon my informing him that I was going to put together a few observations upon the subject, he very obligingly allowed me the use of his memorandum-book, which also related another decisive experiment, upon a large scale, made by a gentleman of his acquaintance It was in consequence of reading Mr. Bryant's treatise, that Mr. Lathbury and this gentleman made their experiments. To these I shall add a few instances, out of many, that have fallen within my own knowledge.

Mr. Lathbury procured two small parcels of wheat, one from a clean sample not at all infected by the Brand, and the other from one which it had much injured. Each parcel he divided into four equal portions, and prepared for sowing as follows, dreſsing one portion from each parcel in the same manner. The first he washed carefully with spring-water, and wiped with a soft dry cloth. The next he dipped in strong white wine vinegar, and allowed to dry upon a sheet of writing paper. A third he covered with salt-water taken from the river, and after letting it remain in it for twelve hours, he wiped it as the first. The fourth portions were not dreſsed at all. The wheat from the clean sample was planted on one side of his garden, and that from the branded one on another. When he sowed the two undreſsed portions, before he covered the seed with earth, he sprinkled upon it some Brand dust. The result of his experiment was, that the three first portions of both sorts which had been prepared for sowing, were very little injured by the Brand. Those which were from seed of the clean sample, had only one ear affected, and that partially. Those from the branded samples, produced two ears that were partially branded, and three that were affected by Smut or Dust Brand (reticularia segetum). But the produce of those portions, which had been sprinkled with the dust of the Pepper Brand, was greatly injured by it, three-fourths of the grain being destroyed. There appeared no difference in the number of plants produced from each portion of the clean seed; every grain vegetated, except in one instance, where it was evident that those which perished were destroyed by an insect: but the number of plants produced from the injured seed was various; that which was washed with water produced the greatest number, and that wetted with vinegar the smallest. Mr. Lathbury, in the dreſsing of the seed for his experiment, does not appear to have used lime; which I should apprehend to be the most efficacious preventive of the evil, though at the same time it may probably be most destructive of the seed. These portions of wheat were sown at Orford on the 20th of September, 1786.

The other experiment was made in the neighbourhood of Woodbridge, in the following year. I shall give it in Mr. Lathbury's words: "Mr. John Woolnough, of Boyton, a most intelligent and excellent farmer, read Mr. Bryant's pamphlet, and in consequence of his arguments, the next year sowed a large field, in alternate breadths with wheat taken from a good sample (without dreſsing), and wheat that had been dreſsed in the usual manner. Long before the corn was ripe, the difference was most distinguishable. Upon those stretches *, sown with dreſsed wheat, it was difficult to find any branded ears, except upon the edges, where it is probable the undreſsed had been occasionally thrown in, sowing it by hand. The other breadths were so branded, as to make it neceſsary for him to determine to carry the corn at separate times to different places. A wet season setting in, the hurry of buſineſs made him neglect this precaution, and being all housed together, the whole crop, when threshed out, was spoiled so much by the Brand dust as to render the sample unsaleable. He computed his loſs at £.50." I shall now copy an instance from Mr. Lathbury's memorandum-book, of mischief incurred by a defect in the quality of the lime used for drying the seed: "Mr. Howlett, of Blighborough-Lodge, always accustomed to dreſs his wheat with salt-water and fresh slaked lime, was induced, from the magnitude of his concern, to purchase a quan-

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* I know not the orthography of this word. It is usually pronounced *stetches*. It is the name given to those breadths, narrower or wider according to the nature of the soil, into which a field is divided previous to sowing.

tity of lime, which, from some circumstances, was offered to him at a much leſs price than usual. When he dreſsed his wheat with it, it was air-slaked, but did not appear otherwise altered by keeping; yet had it so far lost its strength, that his crop that year was injured by the Pepper Brand to the amount of upwards of £.300, in the opinion of good and able judges." Thus far Mr. Lathbury's communications.

I shall now proceed, as I proposed, in the next place to mention some instances which fell within my own knowledge. Last year an intelligent farmer informed me, that through haste he had neglected to dreſs part of his seed-wheat, and that in consequence of it, the crop of the field where it was sown, was greatly injured by the Brand, while the rest of his wheat was free from it. He also informed me, that if old wheat was used for seed, it was not subject to it. During the present year, a gentleman who occupies a considerable tract of land in the parish of Barham, and who is very attentive to farming, told me that in a particular field, the dreſsed seed not holding out, they sowed the headland with what was undreſsed. The consequence was, that this part was very full of the Pepper Brand, while the rest of the field escaped. Another gentleman who was brought up in the medical line, but has now taken to farming, aſsures me, that since he has dreſsed his wheat, he has never suffered from this evil; and so convinced is he of the efficacy of the common method, that he is determined to prepare barley and oats in the same way, in order to prevent the Dust Brand. I could multiply more instances, if neceſsary, from information received from other quarters; but I think these are fully sufficient to prove that Mr. Bryant's hypothesis is not founded upon facts. It seems evident from them, that the mischief is carried with the seed into the field [*], and that the

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[*] It may be objected here, that seed-wheat is always taken from a clean sample, and that, therefore, it is most probable that it should meet with the seeds of the Brand in the soil; but in that case how could the previous dreſsing, especially a single washing, act as a preventive? Old seed, we see, is not subject to it; which must, I should think, arise either from the Brand dust being rubbed off by the frequent friction of the grains one against another, when turned over, or from the latter losing its vegetative principle: but neither of these circumstances would hinder its attack, if the Brand dust were

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usual mode of dreſsing it, acts as a sufficient preventive. From one of Mr. Lathbury's experiments it appears, that the simple washing of the seed with water, if it be carefully wiped, answers all the ends of steeping in a more expensive preparation. This, perhaps, could not be done with sufficient care and accuracy upon a large scale, otherwise the most simple and least expensive method, is certainly the best; and all that seems to be wanted previous to sowing, is thoroughly to cleanse the seed from the Brand dust that adheres to it. Probably wetting the seed with water, and afterwards drying it with fresh slaked lime, would answer every purpose.

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already in the soil. Besides, its remaining within the grain, and not like the Dust Brand eating through the arillus, militates strongly against such a supposition. It is probable that in every wheat-field a few scattered ears may be branded, and these would be sufficient to infect a large parcel of grain; for every diseased kernel contains millions of seeds of the Brand, and the frequent turning over and mixing of the corn would diſseminate these through a considerable quantity. Still I would not be understood to aſsert, that Brand left in the soil never attacks the wheat: such a circumstance may account for its prevalence in some seasons, even where corn has been dreſsed: all I contend for is, that this is not usually the case.

The ſuppoſition that the Brand is produced by inſects, is not ſupported by one fact or experiment that I have ever heard of; indeed the ſingle circumſtance, that the diſorder originates with the ſeed, and from thence paſſes, by ſome unknown channel, into the plant, entirely overturns it. I ſhall not, therefore, loſe time by dwelling upon it, but proceed further to eſtabliſh the third opinion, that the diſorder is occaſioned by a vegetable ſubſtance. The fact occaſioned by the above experiments, that the duſt of Brand, carried into the field with the ſeed-wheat, like other vegetables, propagates itſelf, gives the higheſt degree of probability to this opinion; which is ſtill further confirmed by the reſult of Mr. Lathbury's experiment of ſowing it, as it were, upon its native ſoil, (eſpecially in the caſe of wheat taken from a clean ſample,) which ſeems to have occaſioned the deſtruction of three-fourths of its produce. This is as deciſive a proof as can be deſired of its being a vegetable. But what I think places the matter beyond all doubt is, that this duſt, when put under a powerful magnifier, exhibits every appearance of minute ſeed. I happened to take ſome duſt from branded grains, I think laſt year, which I laid by for future inſpection. After I had begun this paper, I strewed some of that dust upon a piece of glaſs; and putting it under a very strong magnifier over a reflector, I was highly gratified with observing, that every particle of Brand was a globular seed; not the least variation in shape or magnitude was visible amongst them. I afterwards put a drop of water upon them, and let them remain in this situation for some time, but it produced no alteration whatsoever in their appearance. I afterwards examined, in the same way, the dust of one of the stellated Lycoperdons, which I happened to have by me; but the particles of this were much smaller than those of the Brand, and not of a form so visibly determinate. Mr. Lathbury also tried a variety of experiments with the same view; and in every one "the dust, when diluted with water, instantly separated, and presented to the eye invariably a number of globules, touching each other, alike in form and size."

It now remains for consideration, how these seeds vegetate, and ascend from the seed with the growing plant, till they reach the heart of the grain. This is an inquiry that may be extended to a great number of the Fungi, which, without impropriety, may be denominated subcutaneous vegetables; for instance, the several species of Æcidium, (for they are numerous,) Uredo *, and not a few Sphæriæ, except that these latter grow upon decaying substances; but these I shall let alone, and only offer a conjecture, for it is merely such, with respect to the Brand. Perhaps, then, the uncommonly minute seeds of this fungus may attach themselves either to the plumula, and so paſs through the air-veſsels into the plant, or else to the rostellum, which to me seems most probable; and, in that case, they may be propelled through the sap-veſsels with the sap, till at length they arrive at their final seat, the heart of the germen. Whether this species belong to the genus Reticularia, or not, I must leave to be determined by those gentlemen who are more deeply skilled in "cryptogamic lore" than I am.

The next Fungus of the wheat that I shall notice, is that Æcidium known to Agriculturists by the name of the Red Gum. This species grows usually upon the inside of the glumes of the calyx, and of the exterior val-

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* Are Æcidium and Uredo sufficiently distinct?

vule of the corolla, under the epidermis; which, when the plant is ripe, bursts, and emits a powder of a bright orange colour. This little plant, which is now well known[*], does not appear to be materially injurious to the grain, if at all. I have seen ears full of it, with very plump kernels. I have also found it upon branded ears. Before the cuticle which covers the seeds of this fungus bursts, it has very much the appearance of a small pustule upon the human body.

Another plant of this order, which is very common upon wheat, is that named by Mr. Lambert, in the Linnean Transactions[†], and by Mr. Sowerby in his elegant work upon English Fungi[‡], Uredo Frumenti. It grows upon the foliage, culm, and glumes, bursting in longitudinal streaks from under the epidermis. These gentlemen represent this plant as the blight of the wheat, which in certain seasons and soils is so injurious to that grain. I had myself for some time suspected that it was the cause of that disease; but after repeated examination of ears, the straw of which was quite black with it, I had given up that opinion; for in no one instance was the grain injured by it. Yet I would by no means be understood to contradict the aſsertion of these gentlemen in toto. This plant, when it makes its attack before the wheat begins to harden, by depriving it of part of its nutriment, may occasion it to shrink; and Mr. Lambert's own experience seems to confirm this observation: unleſs the mischievous plant, which I shall next mention, had taken poſseſsion of the ear, at the same time that the Uredo Frumenti had discoloured the stalk; for the same circumstances would be favourable to the production of both, although we have reason to be thankful that the latter is much the most common of the two. I doubt not but these gentlemen will readily excuse my diſsent from their sentiments in this instance; and should future examination prove me in the wrong, I shall with pleasure retract. In subjects not thoroughly diſcuſsed and understood, the collision of opinions contributes very much to bring hidden truths to light.

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[*] Linn. Trans. vol. iii. p. 249, 250.

[†] Id. vol. iv. p. 193, 194.

[‡] English Fungi, vol. ii. tab. cxl.

In the year 1797, the wheat suffered much by the blight, or mildew, as our farmers more commonly call it, by far the worst enemy of that grain; and I had frequent opportunities of examining into the cause of it. The ears that were injured by it were to be distinguished at a considerable distance by their blackneſs; and when brought close to the eye, they appeared as if soot, or some other smutty powder, had been strewed over them. Under a common lens (for at that time I had no other) the chaff appeared covered with small black dots irregularly scattered over it, and widely different from the appearance of Uredo Frumenti upon the same part, which is very accurately represented in Mr. Sowerby's figure. Whenever this appearance seizes an ear, it invariably occasions the grain to shrink so much as to be fit for nothing but to feed hogs or poultry. I do not recollect making any observations upon the state of the straw; but I have a memorandum, made in a field from which I took many ears, which says that the straw of the mildewed wheat in that field was clean; and if my memory does not fail me, the mildew itself was always confined to the ear; though sometimes the straw might be affected, as I hinted above, by Uredo Frumenti at the same time. Some farmers, whom I have consulted, have told me that the straw is always injured; but others have confirmed my own observation in the field abovementioned, that it is not invariably so. I should observe, that the foliage of the mildewed wheat in this field was distinguished by another species of Uredo; though perhaps this might be only another appearance of the mildew, which discharged its seed at regular intervals in dots. From the absence of Uredo Frumenti, in this instance, it is evident that the mildew is independent of that plant, and so *vice versa*. A whole district in the neighbourhood of Barham is particularly given to this evil; but improved management of the soil, I am told, will serve as a remedy. The appearance occasioned by the mildew, upon an ear examined under a lens, did not so fully convince me of its being a Fungus, as that of the four preceding species; the dots were too minute to determine with certainty without a more powerful magnifier: yet I am most inclined to that opinion; and it derives additional force from what was once related to me by a gentleman who had been abroad, that an Italian Abbate, I forgot who, had written a memoir upon the subject, in which he had proved the mildew to be a very minute Lycoperdon. He promised to send me the pamphlet, but was not so good as his word. The present year produced no mildew, that I can learn; and I sent my specimens to Mr. Sowerby.

I have now brought to a conclusion what I had to say upon those parasitic Fungi which I have observed upon the wheat; and I hope that these hints, for such only I desire that they may be considered, may induce other gentlemen, more deeply skilled in this department of natural history than I am, to pursue them further. The subject, if viewed as closely connected with Agriculture, is certainly important; and if the study of it should lead to a discovery of a method of preventing the blight, as effectual as that which has long been used by farmers to secure their crops from the brand, the naturalist who led the way to it would have no reason to think that his labours were in vain.

Much has been done in this country towards investigating the Fungi by Meſsrs. Withering, Woodward, Dickson, Bolton, Sowerby, &c.; yet the knowledge of this claſs of vegetables is *adhuc in incunabulis*, and many years must elapse before we may expect to see it upon the same firm footing with the other branches of botany. There is scarcely a leaf (at least of trees and shrubs) falls to the ground, that has not its peculiar Fungus, which, aſsisted by humidity, reduces it to its original earth. The same observation may be extended to sticks * and stalks, and many other substances. The more we attend to these things, the further we shall see into the plan of Divine Providence, and, every step we take, be more and more convinced that there is nothing either deficient or superfluous; but that all things are created in weight and measure, and work together (whether their office be to preserve or to destroy) to promote the best ends by the most efficacious means.

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* Mr. Sowerby, in his English Fungi, (vol. ii. tab. 137,) has given the name of decorticata to a particular species of Sphæria, as suggested by me, probably owing to my bad writing. The name I intended was decorticans, from the circumstance of its growing under the bark, and finally occasioning it to peel off.

# ESSAY XII.

## *On the Management of the Dairy.*

When a dairy is established, the undertaker may sometimes think it his interest to obtain the greatest poſsible *quantity* of produce; sometimes it may be more beneficial for him to have it of the *finest quality*, and at other times it may be neceſsary to have both these objects in view, the one or the other in a greater or leſs proportion. It is therefore of importance he should know how he may accomplish the one or the other of these purposes, in the easiest and most direct manner.

To be able to convert his milk to the highest poſsible profit in every case, he ought to be fully acquainted with every circumstance respecting the manufacture both of butter and of cheese; as it may in some cases happen, that a certain portion of that milk may be more advantageously converted into butter than into cheese, while another portion of it would return more profit if made into cheese. It is not, however, intended, in the present eſsay, to enter into this wide diſcuſsion. Here, it is only proposed to treat of the manufacture of butter, leaving the subject of cheese-making to some other person to treat of, who is more conversant in that department than I am.

The first thing to be adverted to in an undertaking of this nature is, to choose cows of a proper sort. Among this claſs of animals, it is found, by experience, that some kinds give milk of a much thicker consistence, and richer quality than others; nor is this richneſs of *quality* neceſsarily connected with the smallneſs of the *quantity* yielded by cows of nearly an equal size; it therefore behoves the owner of a dairy to be peculiarly attentive to this circumstance. In judging of the value of a cow, it ought rather to be the quantity and the quality of the *cream* produced from the milk of a cow in a given time, than the quantity of the milk itself. This is a circumstance that will be shown in the future to be of more importance than is generally imagined. The small cows of the Alderney breed afford the richest milk hitherto known; but individual cows in every country may be found, by a careful selection, that afford much thicker milk than others; these, therefore, ought to be searched for with care, and their breed reared with attention, as being peculiarly valuable.

Few persons who have had any experience at all in the dairy way can be ignorant, that in comparing the milk of two cows, to judge of their respective qualities, particular attention must be paid to the time that has elapsed since their calving; for the milk of the same cow is always thinner soon after calving, than it is afterwards; as it gradually becomes thicker, though generally leſs in quantity, in proportion to the time the cow has calved. The colour of the milk, however, soon after calving, is richer than it afterwards becomes; but this, especially for the first two weeks, is a faulty colour that ought not to be coveted.

To make the cows give abundance of milk, and of a good quality, they must at all times have plenty of food. Graſs is the best food yet known for this purpose, and that kind of graſs which springs up spontaneously on rich dry soils is the best of all *. If the temperature of the climate be such as to permit the cows to graze at ease throughout the day, they should be suffered to range on such pastures at freedom; but if the cows are so much

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* So little attention has hitherto been beſtowed on this subject, that I do not know of any set of experiments that have ever yet been made, with a view to ascertain the effects of any of the natural graſses that spontaneously spring up in abundance on our fields, either on the quantity or the quality of the milk of cows, and few that have been attempted even with regard to those plants that have been cultivated by art as green forage for them; though it be well known that some particular kinds of plants strongly affect the taste, and alter the quality of particular products of milk. It is indeed, in all cases, confidently aſserted, that old pastures alone can ever be made to afford rich butter or cheese. This, however, I know, from my own repeated experience, to be a popular error, as I have frequently seen much richer butter made by one person from cows that were fed in the house chiefly with cut clover and rye-graſs, than that which was made by others, where the cows were fed on very rich old pastures. Mankind are in general disposed to throw the blame of every failure upon some circumstance that does not reflect on themselves as bad managers. Hence it is that the graſs of a farm is often blamed for the want of richneſs of the butter produced upon it; when, if the circumstances were fully investigated, it would be found to be occasioned by the unskilfulneſs of the dairy-maid, or the want of attention in the choice of proper cows.

incommoded by the heat, as to be prevented from eating through the day, they ought, in that case, to be taken into cool shades for protection, where, after allowing them a proper time to ruminate, they should be supplied with abundance of green food fresh cut for the purpose, and given to them by hand frequently in small quantities fresh and fresh, so as to induce them to eat it with pleasure*. When the heat of the day is over, and they can remain abroad with ease, they may be again turned into the pasture, where they should be allowed to range with freedom all night during the mild weather of summer.

Cows, if abundantly fed, should be milked three times a day during the whole of the

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[*] In very warm climates, where the heat is extremely oppreſsive to cows, and the flies are exceedingly troublesome, sheds open on one side, the roof being only supported there by pillars, would not afford them such effectual shelter as they would require. In these cases, the sheds should be walled up on both sides, and be left open only at the two ends, which, if properly placed, would produce a continued stream of air throughout the whole building, that would prove highly salutary to the cattle.

summer season*; in the morning early, at noon, and in the evening, just before night-fall. In the choice of persons for milking the cows, great caution should be employed; for if that operation be not carefully and properly performed, not only the quantity of the produce of the dairy will be greatly diminished, but its quality also will be very much debased; for if all the milk be not thoroughly drawn from a cow when she is milked, that portion of milk which is left in the udder seems to be gradually absorbed into the system, and nature generates no more than to supply the waste of what has been taken away. If this leſsened quantity be not again thoroughly drawn off, it occasions a yet farther diminution of the quan-

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[*] If cows be milked only twice in the day (24 hours) while they have abundance of succulent food, they will yield a much smaller quantity of milk in the same time than if they be milked three times. Some attentive observers I have met with, think a cow in these circumstances will give nearly as much milk at *each time*, if milked three times, as if she were milked only twice. This fact, however, has not, that I know of, been ascertained by experiment. There can be no doubt but they give more, how much is not ascertained; nor whether it would be advantageous in any case to milk them four times, or oftener; or what effect frequent milking produces on the *quality* of the milk.

tity of milk generated; and so on, it may be made to proceed in perpetual progreſsion from little to leſs, till none at all is produced. In short, this is the practice in all cases followed; when it is meant to allow a cow's milk to dry up entirely without doing her hurt. In this manner, therefore, the profits of a dairy might be wonderfully diminished; so that it much behoves the owner of it to be extremely attentive to this circumstance, if he wishes to avoid ruin. It ought to be a rule without an exception, never to allow this important department to be intrusted, without control, to the management of hired servants *. Its importance will be still more manifest from what follows:

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* Cows should always be treated with great gentleneſs, and soothed by mild usage, especially when young and ticklish, or when the paps are tender; in which last case, the udder ought to be fomented with warm water before milking, and touched with the greatest gentleneſs; otherwise the cow will be in danger of contracting bad habits, becoming stubborn and unruly, and retaining her milk ever after. A cow never lets down her milk pleasantly to the person she dreads or dislikes. The udder and paps should always be washed with clean water before milking; but care should be taken that none of that water be admitted into the milking pail.

In the management of a dairy, the following peculiarities respecting milk ought to be very particularly adverted to; some of them are, no doubt, known in part to attentive housewives, but they never yet, I have reason to believe, have been adverted to as their importance deserves; and by many have never been thought of at all. I put them down in the form of aphorisms, that they may be the more adverted to, and the easier retained.

### APHORISM I.

*Of the Milk that is drawn from any cow at one time, that which comes off at the first is always thinner, and of a much worse quality, than that which comes afterwards, and the richneſs goes on continually increasing to the very last drop that can be drawn from the udder at that time.*

Few persons are ignorant, that milk which is taken from the cow last of all at milking, which is called *stroakings*, is richer than the rest of the milk—but fewer still are aware of the greatneſs of the disproportion between the quality of the first and the last drawn milk from the same cow at one milking. The following facts respecting this circumstance were ascertained by me many years ago, and have been confirmed by many subsequent experiments and observations.

Having taken several large tea-cups, exactly of the same size and shape, one of these tea-cups was filled at the beginning of the milking, and the others at regular intervals till the last, which was filled with the dregs of the stroakings. These were each weighed; the weight of each cup being settled so as to ascertain that the quantity of milk in each was precisely the same; and from a great number of experiments, frequently repeated with many different cows, the result was in all cases thus:

The quantity of cream obtained from the first drawn cup was, *in every case*, much smaller than from that which was last drawn; and those between afforded leſs or more, as they were nearer the beginning or the end. It is unneceſsary here to specify these intermediate proportions; but it is proper the public should be informed, that the quantity of cream obtained from the last-drawn cup, from some cows, exceeded that from the first in the proportion of *sixteen* to *one*. In other cows, however, and in particular circumstances, the disproportion was not quite so great; but in no case did I find it fall short of the rate of *eight* to *one*. Probably, upon an average of a great many cows, it might be found to run as *ten* or *twelve* to *one.*

*2dly.* The difference in the *quality* of the cream, however, obtained from these two cups, was much greater than the difference in the *quantity.* In the first cup, the cream was a thin tough film, thinner and perhaps whiter than the paper on which I write; in the last, the cream was of a thick *butyrous* consistence, and of a glowing richneſs of colour, that no other kind of cream is ever found to poſseſs.

*3dly.* The difference in the quality of the *milk* that remained after the cream was separated, was, perhaps, still greater than either in respect to the quantity or the quality of the cream. The milk in the first cup was a thin bluish liquid, like as if a very large proportion of water had been mixed with ordinary milk; that in the last cup was of a thick consistence and yellow colour, more resembling cream than milk, both in taste and appearance.

From this important experiment it appears, that the person who, by bad milking of his cows, loses but half a pint of his milk, loses in fact about as much cream as would be afforded by six or eight pints at the beginning, and loses besides that part of the cream which alone can give richneſs and high flavour to his butter. Many other useful corollaries may be drawn from it, which I do not at present stop to enumerate. Some of them will occur in the sequel.

### APHORISM II.

*If milk be put up in a dish, and allowed to stand till it throws up cream, that portion of cream which rises first to the surface is richer in quality, and greater in quantity, than what rises in a second equal portion of time; and the cream that rises in the second interval of time, is greater in quantity and richer in quality than that which rises in a third equal space of time; and that of the third than the fourth, and so on, the cream that rises decreases in quantity, and declines in quality continually, as long as any rises to the surface.*

My experiments not having been in this case made with so much accuracy as in the former, I have not been enabled to ascertain the difference in the proportion that takes place in equal portions of time; but they have been so often repeated as not to leave any room to doubt the fact; and it will be allowed to be a fact of no small importance in the management of the dairy. It is not certain, however, but that a greater *quantity* of cream may, upon the whole, be obtained from the milk by taking it away at different times; but the proceſs is so troublesome as not to be counterbalanced by the increased quantity obtained, if indeed an additional quantity be thus obtained, which is not as yet fully certain.

### APHORISM III.

*Thick milk always throws up a smaller proportion of the cream it actually contains to the surface, than milk that is thinner, but that cream is of a richer quality; and if water be added to that thick milk, it will afford a considerably greater quantity of cream than it would have done if allowed to remain pure; but its quality is at the same time greatly debased.*

This is a fact that every person attentive to a dairy must have remarked: but I have never heard of any experiment that could ascertain either the precise amount of the increased quantity of cream that might thus be obtained, or of the ratio in the decrease of its quality; but it ascertains the effects at least of mixing water with the milk in a dairy; and the knowledge of this fact will enable attentive persons to follow that practice which they think will best promote their own interest.

### APHORISM IV.

*Milk which is put into a bucket or other proper veſsel, and carried in it to any considerable distance, so as to be much agitated and in part cooled before it be put into the milk-pans to settle for cream, never throws up so much nor so rich cream, as if the same milk had been put into the milk-pans directly after it was milked.*

In this case, it is believed the loſs of cream will be nearly in proportion to the time that has elapsed, and the agitation it has sustained after being drawn from the cow. But I am not as yet in poſseſsion of any experiments that sufficiently ascertain how much is to be ascribed to the time, and the agitation, taken separately. On every branch of Agriculture, we find experiments wanting at each step we advance in our inquiries. The labours of no one man can complete the whole; but it is the duty of every inquirer to point out as he goes along where they are wanted.

From the above facts the following corollaries seem to be clearly deducible.

1*st*. It is of importance that the cows should be always milked as near the dairy as poſsible, to prevent the neceſsity of carrying and cooling the milk before it be put into the dishes; and as cows are much hurt by far-driving, it must be a great advantage in a dairy-farm to have the principal graſs-fields as near the dairy, or homestead, as poſsible.

*2dly.* The practice of putting the milk of all the cows of a large dairy into one veſsel, as it is milked, there to remain till the whole milking be finished before any part of it is put into the milk-pans, seems to be highly injudicious, not only on account of the loſs that is sustained by agitation and cooling, but also, more especially, because it prevents the owner of the dairy from distinguishing the good from the bad cow's milk, so as to separate these from each other, where it is neceſsary. He may thus have the whole of his dairy product greatly debased by the milk of one bad cow, for years together, without being able to discover it *. A better practice, therefore, would be, to have the milk drawn from each cow separately put into the creaming pans as soon as it is milked, without being ever mixed with any other. Thus would the careful *dai* * be able on all occasions to observe the particular quality of each individual cow's milk, as well as its quantity, and to know with precision which of his cows it was his interest to dispose of, and which of them he ought to keep and breed from.

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* I once saw a cow that gave milk which could never be made to yield any butter at all, though it had the appearance of being very rich milk. The person who sold that cow had had her several years, along with a good many others, without having so much as had any suspicion of this peculiarity. It was only discovered when she came into the poſseſsion of a person who had but one cow,

3*dly*. If it be intended to make butter *of a very fine quality*, it will be advisable in all cases to keep the milk that is first drawn separate from that which comes last; as it is obvious that, if this be not done, the quality of the butter will be greatly debased, without much augmenting its quantity. It is also obvious, that the quality of the butter will be improved in proportion to the ſmallneſs of the proportion of the last-drawn milk that is retained, so that those who wish to be ſingularly nice in this reſpect, will do well to retain only a very small proportion of the last-drawn milk.

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* I beg leave here to adopt a provincial word, which is strongly expreſsive, and much wanted in the English language. *Dai*, or *dey*, in Aberdeenshire, denotes the person who has the superintendance of a dairy, whether that person be male or female. In that sense it is here employed. Dairy-maid, which is the only English word nearly equivalent to it, denotes a person of an inferior station, who, under the superintendance of the former, exercises the menial offices of the dairy.

To those owners of dairies who have profit only in view, it must ever be a matter of trial and calculation, how far it is expedient for them to carry the improvement of the quality of their butter, at the expenſe of diminiſhing its quantity. In different ſituations, prudence will point out different kinds of practice as most eligible; and all perſons must be left, after making accurate trials, to determine for themſelves. It is likewiſe a conſideration of no small importance, to determine in what way the inferior milk that is thus to be ſet apart, where fine butter is wanted, can be employed with the greatest profit. In the Highlands of Scotland they have adopted, without thinking of the improvement of their butter, a very ſimple and economical practice in this reſpect. As the rearing of calves is there a principal object with the farmer, every cow is allowed to ſuckle her own calf with a portion of her milk, the remainder being only employed in the dairy. To give the calf its proportion regularly, it is separated from the cow, and kept in an inclosure along with all the other calves belonging to the same farm. At regular times the cows are driven to the door of the calves' inclosure, where the young ones fail not to meet them. Each calf is then separately let out, and runs directly to its mother, where it sucks till the dairy-maid judges it has had enough, when she orders it to be driven away, having previously shackled the hinder legs of the mother, by a very simple contrivance, to oblige her to stand still. Boys drive away the calf with switches, and return it to the inclosure, while the dairy-maid milks off what was left by the calf. Thus they proceed till the whole of the cows are milked, and thus do they obtain a small quantity of milk, it is true, but that milk of an exceeding rich quality; which, in the hands of such of the inhabitants as know how to manage it, is manufactured into the richest marrowy butter that can be any where met with. This richneſs of the Highland butter is universally ascribed to the old graſs the cows feed upon in their remote glens, but it is in fact chiefly to be attributed to the practice here described, which has long prevailed in these regions. Whether a similar practice could be economically adopted elsewhere, I do not take upon me to say; but, doubtleſs, other secondary uses might be found for the milk of inferior quality; on some occasions it might be converted into butter of an inferior quality; on others it might be sold sweet, where the situation of the farm is within reach of a market-town; on other occasions it might be converted into cheese, which, by being made of sweet milk, would be of a very fine quality if carefully made; and still other uses might be devised for its application *.

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* I shall here mention one mode of managing milk, by means of which the inferior kinds of it might, on many occasions, especially within reach of towns, be disposed of to great advantage. Take common skimmed milk when it has begun to turn sour, put it into an upright stand churn, or a barrel with one of its ends out, or any other convenient vessel. Heat some water, and pour it into a tub that is large enough to contain with ease the veſsel in which the milk was put. Set the veſſel containing the milk into the hot water, and let it remain there for the space of one night. In the morning it will be found that the milk hath separated into two parts, a thick cream-like substance which occupies the upper part of the veſsel, and a thin serous watery part, that remains in the bottom; draw off the thin part (called here *wigg*) by opening a stop-cock placed for that purpose close above the bottom, and reserve the cream for use. Not

*4thly.* If the *quality* of the butter be the chief object attended to, it will be neceſsary not only to separate the first from the last drawn milk, but also to take nothing but the cream that is first separated from the best milk, as it is this first rising cream alone that is of the prime quality. The remainder of the milk, which will be still sweet, may be either employed for the purpose of making sweet milk cheeses, or it may be allowed to stand to throw up cream for making butter of an inferior quality, as circumstances may direct.

*5thly.* From the above facts, we are enabled to perceive that butter of the very best poſsible quality can only be obtained from a dairy of considerable extent, when judiciously managed; for when only a very small portion of each cow's milk can be set apart for throwing

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much leſs than the half of the milk is thus converted into a sort of cream, which, when well made, seems to be as rich and fat as real cream itself, and is only distinguishable from that by its sourneſs. It is eaten with sugar, and esteemed a great delicacy, and usually sells at double the price of fresh unskimmed milk. It requires practice, however, to be able to make this nicely; the degree of the heat of the water, and many other circumstances, greatly affecting the operation. These things practice best discovers.

up cream, and when only a very ſmall proportion of that cream can be reſerved as of the prime quality, it follows, that, unleſs the quantity of milk were, upon the whole, very conſiderable, the quantity of prime cream produced would be ſo ſmall, as to be ſcarcely worth the while for manufacturing ſeparately.

*6thly.* From theſe premiſes we are alſo led to draw another concluſion, extremely different from the opinion that is commonly entertained on this ſubject; viz. That it ſeems probable that the very beſt butter could only be with economy made in thoſe dairies where the manufacture of cheeſe is the principal object. The reaſons are obvious:—If only a ſmall portion of the milk ſhould be ſet apart for butter, all the reſt may be made into cheeſe while it is yet warm from the cow and perfectly ſweet; and if only that portion of cream which riſes during the firſt three or four hours after milking is to be reſerved for butter, the rich milk which is left after that cream is ſeparated, being ſtill perfectly ſweet, may be converted into cheeſe, with as great advantage nearly as the newly-milked milk itſelf.

But as it is not probable that many perſons could be found, who would be willing to purchaſe the very fineſt butter made in the manner above pointed out, at the price that would be ſufficient to indemnify the farmer for his trouble in making it; theſe hints are thrown out merely to ſatisfy the curious in what way butter poſseſsing this ſuperior degree of excellence may be obtained, if they chooſe to be at the expenſe; but for an ordinary market, I am ſatisfied from experience and attentive obſervation, that if, in general, about the firſt drawn *half* of the milk be ſeparated at each milking, and the remainder only be ſet up for producing cream, and if that milk be allowed to ſtand to throw up the whole of its cream, even till it begins ſenſibly to taſte ſouriſh, and if that cream be afterwards carefully managed, the butter thus obtained will be of a quality greatly ſuperior to what can uſually be obtained at market, and its quantity not conſiderably leſs, than if the whole of the milk had been treated alike*. This, therefore, is the practice that I should think most likely to suit the frugal farmer, as his butter, though of a superior quality, could be afforded at a price that would always insure it a rapid sale.

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* Among other reaſons that induced me to ſeparate about the half of the milk, the following may be ſtated. Whilſt I was employed in making the experiments on milk

From these general observations on milk, it is neceſsary we should proceed to particulars. No dairy can be managed with profit, unleſs a place properly adapted for keeping the milk, and for carrying on the different operations of the dairy, be first provided. The neceſsary requisites of a good milk-house are, that it be

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milk above-mentioned, it chanced that among my cows there was one which had miſsed having a calf that season, and still continued to give milk. Her milk, as is not uncommon in these circumstances, tasted sensibly salt. On trying the different parcels of that milk, however, it was perceived that the first-drawn milk was extremely salt to the taste, and that the last was perfectly sweet. On an after trial, made with a view to ascertain what proportion of the milk was salt, it was found that the saltneſs decreased gradually from the beginning, and was entirely gone when nearly one half of the milk was drawn off, so that all the laſt-drawn half of the milk was quite sweet. I intended to have tried if other nauseous tastes that sometimes affect milk, such as that from turnips, cabbages, &c. were peculiarly confined to the first-drawn milk or not; but other avocations prevented me from ascertaining this fact.

cool in summer, and warm in winter, so as to perserve a temperature nearly the same throughout the whole year; and that it be dry, so as to admit of being kept clean and sweet at all times. As it is on most occasions difficult to contrive a place within the dwelling-house that can poſseſs all these requisites, I would advise that a separate building should be always erected, which may, in every situation, be reared at a very small expense, and will answer the purpose much better than any of those expensive structures I have seen, that were built by noblemen or gentlemen for this use.

This structure ought, if poſsible, to be erected near to a cool spring, or running water, where easy acceſs can be had to it by the cows, and where it is not liable to be incommoded by stagnant water.

The intention of such a building, with all its conveniences, is merely to enable the attentive owner of a dairy to keep his milk in a proper degree of temperature, both during the summer and the winter season, without much trouble or expense to himself; as any considerable variation in the degree of heat, tends greatly to derange his operations, and to diminish the value of the products of the dairy. If the heat be too great, the milk suddenly coagulates, without admitting of any separation of the cream, and it is so suddenly rendered sour as greatly to mar every operation; if, on the other hand, the milk be kept in too cold a temperature, the cream separates from it slowly and with difficulty, it acquires a bitter and disagreeable taste, the butter can scarcely be made to come at all, and when it is obtained is so pale in the colour, so small in quantity, so poor to the taste, hard and brittle of consistence, and of so little value in every respect, as to bring a very low price at the market, compared to what it would have produced had it been preserved in a proper degree of warmth.

Experiments have not yet been made to ascertain what is the precise degree of heat that is the most favourable for the different operations of the dairy. From the trials I have made myself, I have reason to believe, that when the heat is from 50 to 55 degrees on Fahrenheit's thermometer, the separation of the cream from milk, which is the most important operation of the dairy, goes forward with the greatest regularity. I am, therefore, inclined to think, that this will be found to be the temperature that ought to be aimed at in the dairy; but I do not here pretend to decide with a dogmatic precision; a considerable degree of latitude in this respect may, perhaps, be allowable; but from the best observations I have been able to make, it seems to me highly probable, that when the heat exceeds 60 degrees, the operations become difficult and dangerous; and when it falls below the 40th degree, they can scarcely be carried forward with *any degree* of economy or propriety. Till farther experiments, therefore, shall ascertain this point, we may take it as a safe rule, that the heat should be kept up, if possible, between the 50th and 55th degree; and to ascertain this point, a thermometer, graduated by Fahrenheit's scale, should be hung up perpetually in the milk-house, to give notice to the owner of any alterations in the temperature that might affect his interest.

In winter, should the cold ever become too great, it might be occasionally dispelled, either by placing a barrel full of hot water, close bunged up, upon the table, where it might be allowed to remain till it cooled—or some hot bricks might be employed for the purpose. This I should prefer to any kind of chaffing-dish, with burning embers in it, as the vapour from the coals (which very soon affects the taste of the milk) would thus be avoided.

The next object that demands attention is, the utensils of the dairy. These in general must, from the nature of the buſineſs, be made of wood, But of late many persons, who affect a superior degree of elegance and neatneſs, have employed veſsels made of lead, or of common earthen-ware, for various purposes in the dairy. But, as the acid of milk very readily diſsolves lead, braſs, or copper, and with these forms a compound of a poisonous nature, such veſsels must be accounted highly pernicious in the dairy, and therefore ought to be banished from it. The same may be said of veſsels of any of the common kinds of earthen-ware, which being glazed with lead, and the glazing soluble in acid, are equally improper. Mr. Hayes has recommended cast-iron as a proper substitute for these; but this metal also is soluble in acids; and though the solution be not poisonous like the others, yet, as it may effect the taste of the products of the dairy, and render their medical qualities different from what they would naturally have been, the use of these also should be laid aside. In short, excepting veſsels of true porcelain, or glaſs, which are greatly too expensive, I know of none that could be with propriety substituted for wooden veſsels, in the dairy. China, or glaſs veſsels, however, for obvious reasons, can never come into general use in the dairy; nor will the sensible husbandman ever think of any other than wooden dishes for his milk; as these, if properly managed, can be kept as sweet and pure as the imagination can conceive. This fact is so generally known, as to render wooden dairy utensils common in most parts of the country, so as that they can be readily procured every where of a proper quality, and form of construction, and therefore nothing more on this subject need be here said.

The creaming dishes (so I call the veſsels in which the milk is placed for throwing up cream) when properly cleaned, sweet, and *cool*, are to be filled with the milk as soon after it is drawn from the cow as poſsible, having been first strained carefully through a close strainer, formed of a large wooden bowl, with a hole at the bottom, covered with a very close sieve of fine wire, (silver wire is best) or hair web woven for that purpose; or thin cloth of any kind, (I should always prefer the wire, as most durable and cleanly) so as to keep back hairs, &c. that may accidentally fall from the cow. These dishes should never exceed three inches in depth, whatever be their other dimensions; and if the plan recommended above of separating the milk into two parts, and of keeping each cow's milk by itself, shall be followed, it would be convenient to have them made of such dimensions as to contain about one and a half, or two gallons English. As soon as they are filled, they are to be placed on the shelves in the milk-house, where they should be allowed to remain perfectly undisturbed till it be judged expedient to separate the cream from them.

The length of time that should elapse before the cream be separated, will depend upon the degree of heat at the time, and the particular views of the owner of the dairy. In a moderately warm temperature of the air, if very fine butter be intended, it should not be allowed to stand more than six or eight hours. For ordinary good butter it may safely be let stand twelve hours, or more; but where the dairy is so large as to afford a sufficient quantity of cream, and where the very best butter is intended, (the milk being to be converted to some other use while yet sweet) it may be separated after standing only two, three, or four hours.

When the cream is to be separated, the milk-pan should be taken from the shelf, and placed on the table. The cream is then to be separated from the edges of the veſsel, to which it firmly adheres, by means of a knife with a blunt edge provided for that purpose, (the blade formed either of *pure* silver or of fine ivory) which should be made to run round the edges of the whole. The cream is then to be carefully drawn towards one side by means of a skimming-dish, and then lifted up with great nicety so as to take the whole without any of the milk, if poſsible. This requires a dexterity of manipulation* that can be acquired by practice alone; but it is of great importance to the succeſs of the dairy that it be well done, for if any part of the cream be left, the *quantity* of butter will be diminished; and if any part of the milk be taken, its quality will be debased. The wooden skimming-dishes commonly employed, seem not to be so handy for this purpose as could be wished. An improvement on this apparatus might be suggested.

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* This may be accounted a cramp word, but it expreſses the idea intended so much better than *operation* or *proceſs*, or any other word in common use, that I could not think of rejecting it; and hope it will soon come to be as generally used as any other word in the language.

When the cream is thus obtained, it ought to be immediately put into a veſsel by itself, there to be kept till a proper quantity be collected for being made into butter: and no veſsel can be better adapted for that purpose than a firm neat-made wooden barrel, in size proportioned to the extent of the dairy, open at one end, with a lid exactly fitted to close it. In the under part of this veſsel, close to the bottom, should be placed a cock, or spigot, for drawing off from time to time any thin serous part of the milk that may chance to be there generated; for should this be allowed to remain, it acts upon the cream in a powerful manner, and greatly diminishes the richneſs of the quality of the butter. The inside of the opening of the barrel should be covered with a bit of close fine wire (silver) gauze netting to keep back the cream, while the serum is allowed to paſs; and the barrel on its stand should be inclined a little forward in the top to allow the whole to run off.

Many persons who have had little experience in the dairy believe, that no butter can be of the finest quality, except that which has been made from cream that has not been kept above one day; but this is a very great mistake. So far indeed is this opinion from being well founded, that it is in very few cases that even tolerably good butter can be obtained from cream that is not more than one day old. The separation of butter from cream, only takes place after the cream has attained a certain degree of acidity. If it be agitated before that acidity has begun to take place, no butter can be obtained, and the agitation must be continued till the time that that sourneſs is produced, after which the butter begins to form. In summer, while the climature is warm, the beating may be, without very much difficulty, continued until the acidity be produced, so that butter may be got; but in this case the proceſs is long and tedious, and the butter is, for the most part, of a soft consistence, and tough and gluey to the touch.

If this proceſs be attempted during the cold weather in winter, butter can ſcarcely be in any way obtained, unleſs by the application of ſome great degree of heat, which ſometimes aſsiſts in producing a very inferior kind of butter, that is white, hard, and brittle, with very little taſte, and almoſt unfit for any culinary purpoſe whatever.

The judicious farmer, therefore, will not attempt to imitate this practice, but will allow his cream to remain in the veſsel appropriated for keeping it, until it has acquired that proper degree of acidity that fits it for being made into butter with great eaſe, by a very moderate degree of agitation, and by which proceſs only very fine butter ever can be obtained.

How long cream ought to be kept before it attains the preciſe degree of acidity that is neceſsary to form the very beſt butter, and how long it may be kept after that period before its quality be ſenſibly diminiſhed, has never yet, I preſume, been aſcertained by any experiments that can be relied on. So little nicety has been obſerved in this reſpect by practical farmers, even thoſe who have a high reputation for making good butter, that few of them ever think of observing any precise rule in this respect with regard to the different portions of their cream, seeing they in general make into butter all the cream they have collected since the former churning, so that the new and the old is all beaten up together; and I can find nothing like a uniform rule established among them as to the time that should intervene between one churning and another, that being usually determined by local or accidental circumstances. I am, myself, inclined to believe, that if the cream be carefully kept, and no serous matter allowed to lodge about it, a very great latitude may safely be admitted in this respect. How long cream may be thus kept in our climate, without rendering the butter made from it of a bad quality, I cannot say; but I can say with certainty, that it may be kept good for a much longer time than is in general suspected, even a great many weeks. It is, however, certain, that cream, which has been kept three or four days in summer, is in excellent condition for being made into butter; and I am inclined to believe, that from three days to seven may be found in general to be the best time for keeping cream before churning; though, if circumstances make it neceſsary, a considerable latitude, in this respect, may be allowed.

If, however, it should chance that any farmer has such a quantity of cream as might be worth his while to churn once every day, there is nothing to prevent him from doing it. He has only to provide a separate veſsel for holding the cream for each day he means it should stand before churning; if three days, three veſsels; if four days, four veſsels; and so on. Thus he might churn every day cream of three days old, or of four, or any other number of days old, that he might incline. In the same manner, if it were found that the cream of two, of three, or of a greater number of days gathering, was required to make a proper churning, it might be easy so to contrive it as to churn every day, as will be obvious to any one who shall think upon the subject. In this way the operations of a dairy may be kept perfectly regular and easy *.

The veſsel in which butter is made, usually

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* Some persons choose to churn the whole of the milk without separating any part of the cream. In this way they obtain a greater quantity of butter, though of an inferior quality. By careful management, however, especially if a portion of the first-drawn milk be separated, very good butter may be obtained; but I think the practice, on many accounts, is not to be recommended.

called a *churn*, admits, in the form of it, a conſiderable diverſity. The ſimpleſt that I have ſeen I ſhould prefer as the beſt, merely becauſe it admits of being better cleaned, and of having the butter more eaſily ſeparated from the milk, than any of the others; this is the old-faſhioned upright churn, having a long handle with a foot to it perforated with holes, for the purpoſe of beating the cream, by being moved upward and downward by hand. But though, for the reaſons aſsigned, I ſhould prefer that form of a churn, other perſons may chooſe that which they like beſt, as all the ſorts, under ſkilful management, will perform the buſineſs perfectly well. Indeed, if the cream be prepared as above directed, the proceſs of churning will be ſo eaſy, as to render thoſe utenſils in general the moſt commodious which can be moſt eaſily filled and emptied.

In the proceſs of churning, much greater nicety is required than moſt perſons ſeem to be aware of. A few haſty irregular ſtrokes may render the whole of the butter of ſcarcely any value, that, but for this circumſtance, would have been of the fineſt quality. The owner of an extenſive dairy, therefore, ſhould be extremely attentive to this circumstance, and should be at great pains to procure a proper person for managing this branch of buſineſs. This person ought to be of a cool phlegmatic temper, sedate disposition and character, and ought never to allow another person, especially those who are young, to touch the churn, without the greatest caution and circumspection. Those who have been used to see cream churned that has not been properly prepared, will think, perhaps, that this would be severe labour in a large dairy for one person; but nothing is more easy, as to the bodily labour it requires, than the proceſs of butter-making, where the cream has been duly prepared.

The butter, when made, must be immediately separated from the milk, and being put into a clean dish, (the most convenient shape is that of a shallow bowl) the inside of which, if of wood, should be well rubbed with common salt, to prevent the butter from adhering to it; the butter should be preſsed and worked with a flat wooden ladle, or skimming dish, having a short handle, so as to force out all the milk that was lodged in the cavities of the maſs. A considerable degree of strength, as well as of dexterity, is required in this manipulation. The thing wanted is to force out the milk entirely, with as little tawing of the butter as poſsible; for if the milk be not entirely taken away, the butter will infallibly spoil in a short time, and if it be much worked, the butter will become tough and gluey, which greatly debases its quality. This butter is in some places beaten up by the hand, which I consider as an indelicate and barbarous practice.

Some persons employ cold water in this operation, which they pour upon the butter, and thus, as they say, wash it; but this practice is not only useleſs, as the butter can be perfectly cleared of the milk without it, but also pernicious, because the quality of the butter is thus debased in an astonishing degree. Nothing is so hurtful in a dairy as water improperly used, which, if mixed in any way with either milk or butter, tends greatly to debase the quality of the last.

When the butter is entirely freed from the milk, if it is to be sold sweet, it may be made up into any form that is most generally liked at the market where it is to be sold. If the heat should be so great as to render it too soft to receive the impreſsion of the mould, it may be put into small veſsels, which may be allowed to swim in the trough of cold water under the table, but without allowing any of that water to touch the butter; there it will in a short time acquire the neceſsary degree of firmneſs, (especially if a little bit of ice shall have been put into the bason) after which it may be taken out and moulded into proper form. It should then be put down, in proper dishes, upon the stone border that surrounds the trough, where it may be kept cool and firm till it be packed up to go to market.

In every part of the foregoing proceſs, it is of the utmost importance that the veſsels, and every thing else about the dairy, be kept perfectly clean and sweet, for without this precaution there neither can be pleasure nor profit derived from it. This is a circumstance so universally admitted, that it may seem superfluous to take notice of it in this place. Yet, though this be generally known and admitted, and though every person who attempts to manage a dairy of any sort may intend to have things clean and proper, they may nevertheleſs be, in some cases, at a loſs for the proper way of effecting their intentions, or of guarding against certain evils, which, if once allowed to take place in the dairy, will not be easily removed. As soon as the cream is separated from the milk, the dishes should be carried out of the milk-house, and immediately emptied, and the skimmed milk applied to the uses that the owner of the dairy judges to be most advantageous to him. As soon after the dishes are emptied as poſsible, they must be well washed with scalding hot water, which should be kept in readineſs for that purpose; and as the naked hand cannot be put among the scalding water, a scrubbing-brush of a proper construction must be kept in readineſs for that use. This may be made of a bunch of wire, firmly bound up with strong pack-thread, where other materials cannot be had; but the stumps of an old heath-besom, after the small twigs have been worn off, firmly bound together, are found to answer this purpose remarkably well, nor ought any thing else to be sought for where that can be had, for this is both firm and tough, so as to stand the work extremely well.

After the dishes have been thus perfectly scalded, and thoroughly scrubbed in every part, they must be carefully rinsed with blood-warm water, and well scoured by hand with a coarse linen cloth. They are then to be turned down, one by one, as they are finished, bottom upwards, upon a clean shelving board to drip. When the whole are gone over in this way, the dairy-maid returns to the first done, and with a dry cloth wipes them one by one as clean as poſsible. They are then placed in ranges, so as to be exposed fully to the action of the sun and air on the inside, that the whole of the moisture may be dried up as quickly as may be; for nothing tends so soon to destroy the sweetneſs that is so desirable in dairy veſsels, as for the moisture to be allowed to remain long about them. Therefore in dull foggy weather, when this cannot be quickly dried up by the external air, it is neceſsary to do it by the aid of fire in the house. As soon as the dishes are thoroughly dried, they must be carried into the shade, and placed in order on shelves to cool, to be in readineſs for use when they shall be again wanted.

But should the milk have been suffered at any time to remain so long in the dish as to become sour, the wood instantly becomes tainted with that acidity, so as to act as a leaven upon any milk that shall be afterwards put into it, which never fails to coagulate without separating any cream, and can neither be employed in making butter nor cheese, and is consequently lost in the dairy. The scalding above described, is by no means sufficient to remove this destructive taint; and as the dishes are totally uſeleſs till that be removed, the following more efficacious proceſs must be adopted:—

Fill the veſsel with water scalding hot, and into that put a considerable quantity of hot ashes, and small red embers from the fire. Stir it about frequently, scrubbing it well in every part with the scrubber. Let this remain a considerable time; then empty the dish, scrub it as usual with scalding hot water, rinsing it well with hot, and then with cold water. Then fill it to the brim with cold water, better if that water can be made to run into it in a continued stream, and flow over the brim; let it stand in this state ten or twelve hours or more, after which wipe and dry it, and if the taint has not been very strong, it will then be fit for use.

If the ashes of your fire should chance to contain very little salt, this operation may perhaps not prove effectual. In that case, add a small proportion of potash along with the embers, &c. or quick-lime may be employed along with the potash, which greatly adds to its cleansing power. But in all cases where recourse is had to this proceſs, take great care that the dishes be well cleaned by the rubber at each time; and that cold water be allowed to stand a considerable time in them, which should be frequently changed, that the whole of the salts may be extracted by it before they be used again.

The dishes for holding the cream, and the churn, require to be scalded, scrubbed, rinsed, and dried, after each time they are used, in the same manner as the milk dishes; but, as a sour taint is not here so prejudicial, it is not neceſsary to guard so carefully against it as in the milk dishes. But if ever this taint should become too strong, it may be diminished by the proceſs above described.

On some occasions a part, or the whole of the butter may, perhaps, be disposed of fresh;

but it must be salted before it can be carried to a distant market. And as this part of the proceſs requires as great nicety as any other, a few remarks on the subject shall be added.

Wooden veſsels are, upon the whole, most proper to be employed for containing salted butter. These should be made of cooper work, very firm, and tightly joined with strong *wooden* hoops. It will be advisable to make them very strong where circumstances permit them to be returned to the dairy; for as it is a matter of considerable difficulty to season new veſsels so well as that they shall not affect the taste of the butter, it is always advisable to employ the old veſsels rather than make new ones, as long as they continue firm and sound. Oak is the best wood for the bottom, and staves and broad Dutch split hoops are to be preferred to all others, where they can be had. Iron hoops should be rejected, as the rust from them will in time sink through the wood, though it be very thick, and injure the colour of the butter: one iron hoop, however, should be put at the top, and another below beyond the bottom, the projection below the bottom being made deep for this purpose. No form is more convenient than that of a barrel, unleſs, perhaps, it be that of a truncated cone, with the apex uppermost; as in this case the butter never can rise from the bottom, and float upon the brine, which it will sometimes do in the under part of a barrel when brine is neceſsary. But this inconvenience may be easily obviated, by driving a wooden peg with any kind of a head into the bottom before it be filled, as the butter closely embracing that head all round, will be kept perfectly firm in its place.

An old veſsel may be prepared for again receiving butter, by the ordinary proceſs of scalding, rinsing, and drying; but to season a new veſsel requires greater care. This is to be done by filling it frequently with scalding water, allowing it to remain till it slowly cools. If hay, or other sweet vegetables, are put into it along with the water, it is sometimes thought to facilitate the proceſs. But in all cases, frequent effusions of hot water are very neceſsary, and a considerable time is required before they can be rendered fit for use. The careful *dai* ought to be particularly guarded with respect to this particular, or he may soon lose his character at market.

After the butter has been beaten up and cleared from the milk, as before directed, it is ready for being salted. Let the veſſel into which it is to be put, after being rendered as clean and sweet as poſsible, be rubbed all over in the inside with common salt, and let a little melted butter be run into the cavity between the bottom and the sides at their joining all round, so as to fill it and make it every where flush with the bottom and sides. It is then fit to receive the butter.

Common salt is almost the only substance that has been hitherto employed for the purpose of preserving butter; but I have found, by experience, that the following composition is, in many respects, preferable to it, as it not only preserves the butter more effectually from any taint of rancidity, but makes it also look better, and taste sweeter, richer, and more marrowy, than if the same butter had been cured with common salt alone. I have frequently made comparative trials with the same butter, and always found the difference much greater than could be well conceived. The composition is as follows:

Take of sugar one part, of nitre one part, and of the best Spanish great salt, (or of Dr. Swediaur's best salt*, which is still better than the former, being cleaner) two parts. Beat the whole into a fine powder, mix them well together, and put them by for use,

Of this composition one ounce should be put to every sixteen ounces of butter†; mix this salt thoroughly with the butter as soon as it has been freed from the milk, and put it, without loſs of time down into the veſsel prepared to receive it, preſsing it so close as to leave no air-holes, or any kind of cavities within it. Smooth the surface, and if you expect that it will be above a day or two before you can add more, cover it close up with a piece of clean linen, and above that a piece of wetted parchment, or for want of that, fine linen that has been dipped in melted butter, that is exactly fitted to the edges of the veſsel

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* Dr. Swediaur carries on a manufacture of salt at Prestonpans, near Edinburgh, after the Dutch method; this the Dutch sell by the name of salt upon salt; it is equally strong with the best Spanish salt, and much freer from impurities of every sort, and the Doctor sells it at a moderate price. Were this salt sufficiently known to be brought into general use for curing fish, butter, beef, pork, bacon, hams, tongues, and other articles of provision, it would much promote the prosperity of this country, as these could be as well cured by it as with foreign salt, and at a much smaller expense,

† It is of great consequence that every proceſs, which requires much thought or nicety, should be banished, if poſsible, from all branches of manufacture. On this principle, as some difficulty might arise in proportioning the quantity of salt to unequal weights of butter, I should advise that every person who means to adopt this practice at large, should begin with providing himself with a steelyard so constructed as that sixteen ounces in the one scale

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scale is exactly balanced by one in the other. And that he may be at no loſs to provide himself with this simple apparatus, the following directions may be attended to:

Let him provide two scales of equal weight; one of them should be of wood, and flat for the butter, no matter what form or materials the other is of; let him then take a slip of deal two inches broad, half an inch thick, and two feet long. Near to each end, and at about half an inch from the same side at each end, make a hole through the board, to which the scales may be fastened by means of a loop of wire; observe, that these two holes should be placed exactly at the same distance from the edge. Let him then load the two scales, one of them with one ounce, and the other with sixteen, and having drawn a line parallel to what will now appear to be the upper side of the beam, at half an inch from the top all along on each side, let him be provided with two sharp-pointed instruments, all round, so as to exclude the air as much as poſsible, without the aſsistance of any watery brine ; when more butter is to be added, these coverings are to be taken off, and the butter applied close above the former, preſsing it down and smoothing it as before, and so on till the veſsel be full. When it is quite full, let the two covers be spread over it with the greatest care, and let a little melted butter be poured all round the edges, so as to fill up every cranny, and effectually exclude the air. A little salt may be then strewed over the

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ments, such as a shoemaker's awl: Let him then try to find a point in the new-made line on each side of the beam, where, when the beam is allowed to vibrate on his awls placed directly opposite to each other, the two weights balance each other. This point he will soon discover to be much nearer one of the ends of the beam than the other. Through this point let him pierce a hole by means of a round hot iron. Through this hole put a piece of thick iron wire, which, if supported at each end, will serve as a pevot. The apparatus is now complete.

And whenever it is afterwards wanted, nothing more is neceſsary than to place the butter, whatever be its weight, into the butter-scale, and then put as much of the composition into the opposite scale as brings the beam to a balance: and this will, in all cases, be the due proportion of salt for the butter, whatever the weight of that butter may be.

whole, and the cover be firmly fixed down to remain close shut till it be opened for use. If all this be carefully done, the butter may be kept perfectly sound in this climate for many years. How many years I cannot tell; but I have seen it two years old, and in every respect as sweet and sound as when it was only a month old.

It deserves to be remarked, that butter cured in this manner does not taste well till it has stood at least a fortnight after being salted; but after that period is elapsed, it eats with a rich marrowy taste, that no other butter ever acquires; and it tastes so little salt, that a person who had been accustomed to eat butter cured with common salt only, would not imagine it had got one-fourth part of the salt, that would be neceſsary to preserve it*.

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* But after this butter has been cured in the most perfect manner, it may chance to be much debased in its quality by being improperly treated during the time it is using. Therefore, observe, that when it is broken up for use, a small portion should be pared from the surface all over, especially near the edges, in case the air should not have been so entirely excluded as it ought to have been,

Butter thus cured would bear to be carried to the East or the West-Indies, and would keep sweet during the longest voyage, if it were so packed as not to allow the butter to be so far melted as to occasion the salts to separate from it. But as none of these salts admit of any chemical union with the butter, it must happen, that if ever the butter be so far melted as to become of a fluid consistence,

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been. If it be to be quickly consumed, it may be then spooned up as it is wanted, without any other precaution than that of keeping it carefully covered up so as to exclude dust, &c. from having acceſs to it. But if it be to be used very slowly, and if the perſon to be employed in spooning it up be not very careful, or so indolent as not to be at the trouble of closing it up at each time with the covers, it may happen that the part which is thus long exposed to the air may contract a small degree of rancidity. To guard against this evil, in these circumstances, when the veſsel is opened, let a strong brine of common salt be prepared that will swim an egg, and poured, when cold, upon the surface of the butter; this will cover that surface effectually, even though the operator should be a little careleſs, and will thus guard against the inconvenience complained of: for though the quality of the butter will thus be injured in some degree, in consequence of the water acting upon it, yet that is an evil of far leſs material moment than the slightest degree of rancidity would occasion.

the salts drop to the bottom, and the butter, deprived of their antiseptic powers, quickly becomes rancid. It would be a great improvement in the culinary art, if any antiseptic substance could be found that poſseſsed any agreeable taste and flavour, which was capable of being diſsolved in oily substances. This might afford a proper subject for a premium by the Bath and other Societies. In the mean time the following hints on this subject may be of some use.

Butter, in its natural state, contains a considerable proportion of mucous matter, which is more highly putrescible than the pure oily parts of the butter. Where it is, therefore, intended that butter should be exposed to the heat of warm climates, it ought to be freed from that mucilage before it be cured and packed for keeping. To prepare butter for a distant voyage, therefore, in warm climates, let it be put into a veſsel of a proper shape, which should be immersed into another containing water. Let the water be gradually heated till the butter be thoroughly melted; let it continue in that state for some time, and allow it to settle; the mucous part will fall entirely to the bottom, and the pure oil will swim at top, perfectly transparent while hot, but when it cools it becomes opaque, aſsumes a colour somewhat paler than the original butter before it was melted, and a firmer consistence, more nearly resembling that of tallow, and consequently it will better resist the heat of a warm climate than butter itself. When this refined butter is become a little stiff, and while it still is somewhat soft, the pure part should be separated from the dregs, and then salted, and packed up in the same way as is directed for butter. This would retain the salt longer, and keep much longer sweet in hot climates, than if it had been cured in its original state.

This refined butter may be preserved in yet another way, which I have sometimes seen practised here by way of medical *bonne bouche*. After the butter is purified, add to it a certain proportion of firm honey, mix it well, it will incorporate thoroughly with the butter, and when cold it eats very pleasantly spread on bread like butter; and may be given to old people, if they relish it, instead of marrow, and to others, as being useful for coughs and colds. These were the uses to which I have seen this substance applied, and on these occasions the proportion of honey employed was considerable. I have seen it kept for years, without manifesting the smallest tendency to rancidity, so that there can be no doubt but that butter might thus be preserved in long voyages without spoiling. The only point that remains to be ascertained is, what is the smallest proportion of honey that would be sufficient to preserve the butter. Sugar is known to be a much more powerful antiseptic than common salt, and probably honey may be in that respect nearly on a par with sugar. If so, it would be reasonable to suppose that one ounce of honey might be sufficient to preserve sixteen ounces of butter. In that case the taste of the honey would not be extremely perceptible, so that the butter, even to those who might not relish the sweet composition above-mentioned, might prove very agreeable, especially if a little salt were mixed with it when about to be used. A few experiments would be sufficient to ascertain this particular.

From the circumstance of the honey incorporating with the butter, and not separating from it while in a fluid state, it would promise nearly to accomplish the purpose wanted above. Whether, when it became very fluid, was long continued in that state, any separation would take place; or whether the honey in these circumstances would be in danger of fermenting, are questions that experience alone can determine. Sugar, though it would preserve the butter equally well while it continued in a solid state, would doubtleſs separate from it when it became fluid.—Whether molaſses would do so, or what effects they would in this case produce, I cannot tell; but a few experiments would ascertain these points. Should any method of preserving butter in warm climates be discovered, it would be productive of many benefits to individuals, and to the nation at large, by giving an opening for a new branch of commerce and manufacture, that it is much to be wished the few experiments wanted to ascertain these points were made with such care, under the direction of persons who would faithfully report the result to the public, as should be sufficient to remove all doubts upon this head.

# ESSAY XIII.

## *On the Converſion of Graſs-Land into Tillage.*

BEFORE the propriety of ploughing up old pastures is discuſsed, it may be proper, in the first place, to point out some of the most important advantages to be derived from them.

### I. *Advantages of Old Pastures.*

1. The first advantage contended for is, that old pastures answer better for making butter and cheese than artificial graſses, and the idea is probably well-founded. All seeds, particularly clovers, give the milk a strong taste, and although the quantity may be as great, or even greater, yet the quality is always worse; it will cast up leſs cream in proportion; the butter is leſs firm and waxy, and it will not keep so well. The cheese, also, is considerably inferior.

2. It is next aſserted, that old pastures are better calculated for feeding cattle and sheep;

but this can only be admitted with certain qualifications. In the opinion of that respectable farmer, Mr. Culley, (who has had 50 years experience in the grazing line) "Artificial graſses, suited to the different soils, will be found to answer better than old graſs, for feeding cattle, ewes, and lambs, during the beginning, and for the greater part of the summer; and even during the autumn, artificial graſses will feed ewes and lambs better than old graſses; whereas, on the other hand, fogs (or after-maths, as they are called in the southern parts of England) from old graſs, will certainly feed cattle better in the autumn, the richneſs, luxuriance, and strength of such herbage, being better calculated for their constitutions." It is believed, indeed, that it is hardly poſsible to fatten a large ox, to any degree of perfection, on herbage alone, without such pastures.

3. It is farther contended, that the hay made from old graſs, though not so bulky, yet is of a better quality, and will keep longer in a good condition, than hay made from artificial graſses, particularly from a mixture of clover and rye-graſs.

## II. *Deſcription of the Lands that ought to be kept perpetually in Graſs.*

As old pastures are attended with such peculiar advantages, it is desirable to know, what description of land ought to be kept perpetually in graſs. It is certain that there are many old grazing pastures, which can afford to pay a considerable permanent rent in graſs, even at a distance from any populous town, the value of which might be reduced, if subjected to the plough. It is the opinion of Mr. Culley, that soft heavy loams, with a clayey or marly bottom or substratum, are universally injured by ploughing. Water-meadows also, should never be ploughed, as they furnish so large and valuable a produce in spring, in summer, and in autumn, without any other help than water, whilst the manure made from that produce, goes to enrich the rest of the farm.

With these exceptions, and that of land apt to be overflowed, there is every reason to believe, that old pastures may occasionally be converted, with public advantage, and private benefit, into arable land.

## III. *Obstacles to the Conversion of old Pastures into Tillage.*

Before the conversion of old pastures into tillage is recommended, it is right to consider, what are the obstacles which may stand in the way of such conversion; for, unleſs they are removed, any recommendation to that effect would be useleſs. These obstacles are, 1st, Tithes; and, 2d, The restrictions of the landlord.

In regard to tithes, whilst they continue undefined, they operate in a peculiar manner against the conversion of old graſs-lands into tillage, by depriving both the landlord and the tenant of so large a portion of the profit to be derived from it; and as there is every reason to believe that a very considerable extent of land in England is kept perpetually in graſs, in order to avoid the payment of tithes in kind, is it not a most unfortunate circumstance, that some means are not thought of, for commuting, on equitable terms, a right that operates injuriously to the agricultural interests of the country?

As to the restrictions of the landlord, they are often neceſsary for the protection of his property: And in the course of this inquiry, I shall point out the conditions under which old pastures may be ploughed up, not only without detriment, but with advantage to the landlord, and to the public.

### IV. *Preparation of the Soil.*

The preparation for the tillage crops, may be considered under three heads: 1st, Draining; 2d, Paring and burning; and, 3d, Manuring.

In regard to *draining*, it should be done effectually, before the land is attempted to be ploughed; for very poſsibly it may have been kept in pasture, on account of its wetneſs.

As to *paring* and *burning*, it is certainly a useful practice, where old graſs-lands are broken up, for it destroys numberleſs eggs and larvæ of insects, which are extremely injurious to the succeeding crops, and it almost insures the tenant from any damage he is otherwise likely to sustain from wire-worms, grubs, &c. Indeed, where the land is rough with furze, bushes, brambles, ant-hills, &c. it is hardly to be dispensed with. If the land is so smooth and friable, that paring and burning is not neceſsary, the best plan to adopt is, *to double-*

*plough it*, by means of two ploughs following each other, the first plough taking off a thin surface of about three inches, and the second going deeper in the same place; both furrows not to exceed six inches. Mr. Ducket's skim-coulter does the work at one operation. This plan is certainly the best to pursue, where paring and burning, from prejudice or any other circumstance, will not be permitted.

As to *manuring*, if the land is not to be pared and burnt, lime might be spread on the surface, sometime before ploughing, in order to destroy grubs and insects. Old pasture-lands are in general rich enough to be abundantly productive, without dung, until they are about to be laid down into permanent pasture.

### V. *Course of Crops.*

The rotation of crops must depend upon the nature of the soil, and the manner in which it is prepared for cultivation.

If the land is pared and burnt early in the season, turnips is the best article that can be sown; and it is found, by experience, that turnips thus raised, will go farther in feeding cattle or sheep than any other. If it is late in the season before the land is burnt, cole or cabbage may be adopted: if the land is broken up without being pared or burned, early oats will be found the most profitable crop, being so extremely productive on all fresh clean ground. Mr. Culley states, that there are various sorts of early oats, suited for the different soils: for instance, on rich lays of strong loam, *Polish oats* ought to be preferred; of which that sort called *Church's oats*, is by far the best variety. On lighter soils, the *Dutch* or *Friezland oat*, has been found to answer best: but, on the whole, on loamy soils, no species has been found comparable to the *Potatoe oat*, so called from its having been accidentally found in a field of potatoes, in one of the northern counties. In regard to the succeeding course, on dry soils, turnips, potatoes, and clover ought to be the prevailing green crops; on mixed soils, beans may be added; and when the mixture inclines to heavineſs, cabbages. The following rotation is particularly recommended, on a lightish soil, by Sir Alexander Ramsay; namely, 1st, Oats; 2d, Turnips, with dung and lime; 3d, Barley, with seeds; 4th, Clover; 5th, Wheat; 6th, Turnips; 7th, Barley and graſs-seeds; and then to remain in pasture. This intelligent and respectable farmer is decidedly of opinion, that a full rotation of seven years is to be preferred to a shorter time, with a view of enabling the tenant to profit by his labour, and thoroughly to pulverise and reduce the soil; it may then be laid down in an husbandlike manner, enriched and not exhausted, and likely to produce both hay and pasture in abundance and perfection.

### VI. *Management during the Rotation.*

When land of a light quality is laid down with turnips, sheep should be folded on them. If the land is strong or wet, the green crops grown thereon, ought to be drawn, and fed in some adjoining graſs-field, or in sheds. If the land is in very high condition, some farmers would be inclined to cart off half the turnips, and to eat the rest on the ground, though it is not a plan to be universally recommended.

In regard to manuring, it may be proper to observe, that the dung and lime ought to be applied to the turnips, or other green crops, but never to the different sorts of grain.

### VII. *Mode of laying down to Graſs.*

Graſs-seeds, in general, should be sown with the barley, or the crop succeeding turnips, or any other green crop that may be preferred: the *quantity* of graſs-seeds must be governed by the state and quality of the soil. Old tillage-land requires, in addition to the clover, three pecks, or one bushel of rye-graſs seed per acre; whereas new ploughed lands may do with half that quantity, or even leſs. Heavy lands require from 10 to 14lbs. of red-clover, if they are not to be broken up again in one or two years; but if they are to remain in graſs, from 4 to 6lbs. of marle-graſs, or perennial red-clover, and 4lbs of white. All dry soils may have from 2 to 4 lbs. of hop or yellow clover seed per acre, in addition to the white clover seed, and the perennial red-clover, or marle-graſs already-mentioned. The following plan is recommended by Mr. Bridge, (a respectable farmer in Dorsetshire) for laying down land for permanent pasture; namely, to sow from 6 to 7 lbs. of white-clover, ditto marle-graſs, ditto of hop-clover, and one bushel of the best Devonshire rye-graſs, which resembles much the Pacey rye-graſs. By this means there is a perpetual feed for five or six years. The hop-clover and rye-graſs flouriſh early in the spring; the marle-graſs is in perfection in July, when the other goes off; and the white clover is in perfection in Auguſt, and continues during the remainder of the season. In some meadows of very rich soil, perhaps lucerne ought to be preferred; and it would be of infinite importance to have it aſcertained to what extent that culture could be carried.

As to providing the seed, much muſt depend upon the character of the tenant; but as farmers, in general, are too fond of the plough, it is the ſafest plan for the landlord to provide the seeds, as it must be for his intereſt to procure the best that can be purchased, to prevent any neceſsity, from the unproductive ſtate of the graſs, to have again recourse to tillage.

## VIII. *Increase of Rent.*

It is evident, that any tenant would be willing and able to give an increase of rent, for the liberty of ploughing up old pastures. What the addition ought to be, must be governed by the situation, the quality of the land, the price of grain and other circumstances. In Scotland double rent, and upwards, is not unusual on a lease of four years. The Earl of Rosebery has lately let about 300 Scotch acres of old pasture, at that rate, some part of which produce 8l. per annum [*]. It had been pastured, however, for more than sixteen years, and was situated within eight miles of Edinburgh. The high rent payable for such lands in Scotland, may be attributed to the following circumstances:

1st, That land fit for tillage, is leſs abundant in the northern part of the island than in England. 2d, That old pastures are peculiarly well calculated for producing oats, the general food of the people [†]. 3d, That such lands are in general, so rich, as to require but little manure, consequently the manure arising from the crops they produce may, in a great measure, be devoted to the improvement of the rest of the farm. 4th, That the tenants in Scotland are not subjected to the payment of tithes, nor of poor rates, or other taxes: And, 5th, That there is either a greater spirit of speculation among the Scotch farmers, or that they are contented with leſs profit than the English.

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[*] Equal to 6l. 8s. per English acre. In many instances, old pasture land would fetch in Scotland from 8l. to even 10l. per English acre.

[†] It appears, from the corn tables, that wheat is almost always cheaper in Scotland than in England, and oats the reverse,

## IX. *Conditions under which the Liberty of Ploughing may be granted.*

But the increase of rent is not the only particular that a landlord has to take under his consideration, when he grants the liberty of ploughing up old pastures. Unleſs care is taken, when they are broken up, that it is done under a proper system of management, the execution of which is enforced by the strictest regulations, *the real value of the property may be materially injured.* The conditions, therefore, that ought to be stipulated by the landlord, is certainly not the least important branch of this inquiry.

In considering the general nature of the conditions that ought to be required, I have derived much benefit from perusing the articles which were obligingly communicated to me by the Earl of Roseberry, and according to which that noble Lord, in January, 1801, let a considerable tract of old pasture, part of the estate of Dalmeny, in the neighbourhood of Edinburgh.

Art. 1. By this article the fields were to be set up to auction, and the highest bidder was to find security to fulfil the terms he had agreed to.

Art. 2. The grounds were let for four years: 1st crop, *oats;* 2d crop, *turnips, or other green crops;* (if a naked fallow, four ploughings;) 3d crop, *barley and graſs-seeds,* with two or three ploughings; and, 4th crop, *hay;* prohibiting wheat, hemp, flax, &c. under the penalty of 10l. per acre of additional rent.

Art. 3. The tenant to plough the land properly; to hoe and weed it, &c.; to sow with the third crop at least one bushel and a quarter, or one Scotch firlot of rye-graſs, 12 lb. or 14 lb. good red clover-seed, and 4 lb. white clover, and sufficiently to harrow, stone, and roll the same, entirely at his own expense.

Art. 4. The tenant to have liberty to cut and carry away the foggage, or second crop of graſs, in the fourth or last year, but not to pasture the same *, and to remove every article belonging to him, on or before the 1st of November, 1804.

Art. 5. The tenant to preserve the gates and fences, to keep the ditches, &c. clean and open, and to leave them in good condition at his removal; and, if neglected, the same to be done by the landlord, at the tenant's expense.

Art. 6. The tenant who shall be preferred, to sign a proper deed or instrument, with a sufficient surety, specifying the terms agreed upon.

Art. 7. Accommodation given to the tenant to stack and thresh the crop, under certain obligations, that he shall keep the barn and corn-yard in repair.

Art. 8. An arbiter appointed to determine all differences, the expense attending any dis-

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* This restriction was intended for the preservation of young fences; but where the fields are completely fencible, Lord Roseberry prefers obliging the tenant to pasture the second crop of clover.

pute, to be paid by the persons against whom judgment shall be given.

Art. 9. Tenants to remove, without the neceſsity of previous notice, under certain penalties.

Art. 10. Power reserved to the landlord, or to persons he may appoint, to inspect the fields from time to time, also to work coal and limestone, and other stones or gravel, to sink or dig pits, to make roads, and to do every thing neceſsary for carrying on such works, (allowing to the tenant the yearly value of the ground thus taken up, or rendered uſeleſs,) also, reserving the power of carrying off wood and underwood, paying the damages arising therefrom.

It is evident that, under such prudent conditions as these, if properly enforced, the most cautious landlord may suffer old pasture lands to be converted into tillage, without any material risk of his property being thereby injured.

## X. *On the Propriety of laying down some of the Tillage Land into Graſs.*

Wherever circumstances will admit of it, the landlord would find it for his advantage, to lay down the same quantity of old arable land into pasture that is broken up from pasture, and rendered arable, by which change the farm will, on the whole, be much improved; and consequently it is for the interest of the landlord to consent to the alteration. It is, at the same time, in the opinion of one of our most intelligent farmers, (Sir Alexander Ramsay,) one of the most difficult operations in husbandry, to lay down old tillage land, that has been for years under a ploughing system; (as, 1st, under fallow; 2d, wheat; 3d, beans, &c.) into permanent pasture. One rotation will not be sufficient to produce good pasture; it may be found neceſsary to have two complete rounds of management, different from what the land has been accustomed to: As, 1st, turnips, cabbages, or summer-fallow; 2d, barley, with 12 lb. of clover, and one-half bushel of rye-graſs, to each acre; 3d and 4th, clover to stand two years; 5th, clover stubbed, broke up for drilled beans or peas, according as the land is heavy or light;

6th, turnips, with manure; 7th, barley and graſs-ſeeds for permanent paſture. When the field in this courſe has been twice manured, it has never failed to produce good paſture, more eſpecially if care be taken, the firſt year, to feed it off with ſheep.

### XI. *On the greater productiveneſs of Arable, compared to Paſture Lands.*

Having thus ſhortly ſtated the manner in which old paſture lands may be converted into tillage, it may be proper briefly to explain how much the public is intereſted in ſuch a converſion, in conſequence of the much greater quantity of food for man that is produced by land in tillage. According to Archdeacon Heſlop's comparative ſtatement, lately publiſhed, the weight of food from an acre of arable, on the average of three years, a fallow year being included, is nine and a half times greater than from an acre of feeding ſtock; and, according to the calculations of a very intelligent correſpondent of the Board of Agriculture, the Rev. Dr. Walker of Collinton, a Scotch acre of land in paſture, fed with ſheep, produces only 120lb. weight of meat; whereas the ſame land will yield 1280lb. weight of oatmeal, or above ten times as much *. This is ſo important a circumstance, in a public point of view, that it merits particular attention, as it tends to prove, that where one million of people may be maintained by paſturage, from nine to ten millions may be maintained by tillage.

On the whole, though it may not be adviſable to recommend the ploughing up of very rich old pastures, or water-meadows, or land apt to be overflowed, yet, with these exceptions, there is every reason to believe, that other sorts of graſs-lands may be rendered much more productive, by being occaſionally converted into tillage; and, for that purpoſe, it is desirable that the conversion of such lands should be promoted as soon as poſsible, by removing the obstacles to such conversion,—by enforcing the neceſsity of commuting tithes, without which no considerable tract of old pasture can be broken up,—by pointing out to landlords the conditions under which they may agree to such a plan, not

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* If cultivated in whole, or in part, with potatoes, the difference would be still greater.

only without detriment to the real value of their property, but also yielding a most important addition to their income,—and, above all, by explaining to Parliament, and to the public, that the measure above recommended is one which may effectually tend to prevent future scarcities, and to render this country independent of foreign nations, in the important article of provision.

# ESSAY XIV.

## *On Improving small Arable Farms.*

It is generally thought, and on very good grounds, that small arable farms do not afford the occupier so good a maintenance as dairy farms of the same annual value. That the latter will do well and save money, while the former, with a vast deal more labour and trouble, is starving himself and family. A method of placing these two persons upon an equal footing is greatly to be wished for. An attempt to effect which, is the intention of this Eſsay.

The advantage and propriety of applying land to the growth of such articles to which nature has most fitly suited it, is well known, and also that all land which is naturally and properly arable, can by no means be converted into meadow, or valuable pasture of any duration. Land overrun with furze, fern, bushes, and brambles, and which has been rendered fertile by means of the plough, must be kept in that improved state by its frequent use, otherwise it would soon revert to that wild barren state which was its original condition.

A farm, therefore, which consists wholly, or almost so, of land that is properly arable, must ever continue arable; for it is not practicable to render it in any degree fertile, but by means of the plough; or to keep it long so, even when it is made so. But though arable land cannot be converted into meadow or pasture proper for a dairy, it may be planted with articles which, it is well known, will answer the purpose of feeding horned cattle, especially milch-cows, as effectually as good meadow or pasture, producing as much milk, and altogether as rich, as sweet, and as good.

But the great interesting question is, Whether those articles which can be procured only by the heavy expenses of ploughing, harrowing, seed, and other operations which neceſsarily attend their culture and harvesting, will afford as much sustenance in proportion to the expense, as meadow or pasture which is liable to little or none, excepting what is made into hay, the cattle gathering it for themselves as they consume it?

To ascertain this fact, we must inquire, what may be the average expense of keeping a milch-cow on a dairy-farm for any given time? It is said, upon very good authority, that the expense generally is from 3l. to 3l. 10s. per annum. Two acres and a half of pasture, fit for this use, is sufficient to keep a cow the whole year through, and such land is valued at from 25s. to 30s. per acre. At 25s. suppose, the keeping of each cow would amount to 3l. 2s. 6d. per annum. A dairy farm, therefore, consisting of forty-eight acres, at 25s. per annum, would amount to 60l. rent per annum; and the number of cows that might be kept upon such a farm, allowing two acres and a half to each cow, would be nineteen and a fraction, therefore we will say twenty.

In the next place, let us inquire, what would be the average expense of keeping a cow upon food raised in arable land as a succedaneum to graſs, &c. rent and every neceſsary expense included?

We are aſsured, by unquestionable authority, that a bushel of potatoes, given half at night and half in the morning, with a small allowance of hay, is sufficient to keep three cows a day. On that allowance, their milk will be as rich and as good, and the quantity as great, as in the summer months, when the cows are in good pasture.

I take it for granted, that an acre of land, properly cultivated with potatoes, will produce 337 bushels, and that the total expense of cultivation, rent and tithe included, will be 6l. 13s. 7½d. If three cows eat seven bushels per week, then they would eat 365 bushels in a year; and twenty cows would consume 2433 bushels. The question then is, If 20 cows require 2433 bushels to keep them a year, and, as above, an acre of land properly cultivated, will produce 337 bushels nett, how many acres will be required to produce 2433 bushels, or the quanity necessary to feed 20 cows to keep them in full milk the year round? the answer is, Seven acres and a quarter, nearly.

If then an acre of land can be cultivated with potatoes, as above, for 6l. 13s. 7½d. the cultivation of seven acres and a quarter will amount to 48l. 8s. 9½d. We have seen, as above, that the rent of a dairy farm, capable of maintaining 20 milch-cows, is, upon a medium, 60l.; but it clearly appears, that the same number of cows may be kept equally well on a very small part of an arable farm, planted with potatoes, for 11l. 11s. 2½d. leſs than that sum, which is so much in favour of the arable farm; or, in other words, seven or eight acres of arable land, under this mode of management, are as much superior to forty-eight acres of meadow or pasture, as the difference of the two sums mentioned; the arable farmer receiving as great a sum for the expenditure of 48l. 8s. 9½d. as the dairy farmer doth for his bare rent of 60l. without reckoning a penny for incidental expenses.

It must be observed, that in this statement no allowance is made for the small quantity of hay given to the cows with the potatoes. It must be noted also, that the account of cultivation is charged with 40s. an acre for manure, and some expense of ploughing, which of right is chargeable to the crop of wheat that is to follow. Now if we deduct 40s. an acre from the expense of cultivating the potatoes, it reduces the sum to 4l. 13s. 7½d. and the whole expense then upon seven acres and a quarter is only 33l. 18s. 9¼d. and consequently the keep of twenty cows is little more than half to the occupier of the arable farm, what it is to the occupier of the grazing farm. If this conclusion be fairly drawn, and the calculation free from errors, as I hope and believe, it is matter of the greatest importance, especially to the little arable farmer. It plainly raises him from a state of acknowledged great inferiority, to one altogether as superior.

It may be said, this calculation respects potatoes only; how will this mode of culture answer when applied to the growth of other articles of food used as a succedaneum to herbage? Let us try.

By an experiment lately made, on a pretty large scale, by Mr. Vagg, it appears, that cabbage, on arable land, is much about as superior to natural pasture as potatoes.—His experiment was made on twelve acres of land, which was very far from being the most suitable for a crop of cabbage. The average value about 20s. per acre, and the whole expense of the culture, carting off included, 1l. 14s. 1d. per acre. The rent and expenses of cultivating the twelve acres then amounted to 38l. 9s. He says the stock he fed with it was forty-five oxen, and upwards of sixty sheep; that it fed them three months, and that he is very well aſsured that they improved as fast upon it as they do in the prime months of the season, May, June, and July. Now if, instead of sixty sheep, we reckon fifteen oxen, or that four sheep are about equal to one ox, in which we cannot err much; then sixty oxen were kept well for three months, or, which is the same thing, fifteen oxen for a whole year, for 38l. 9s. and consequently twenty would cost 51l. 5s. 4d. which is not quite 8l. more than the keep of twenty cows cost in potatoes.

It is somewhat extraordinary that two experiments, made on articles so very different in their nature, should so nearly coincide in their effects, when applied to the same purpose. Turnips, turnip-rooted cabbage, carrots, parsnips, and some other articles, by many experiments often repeated, have been found quite adequate to the same valuable purposes, at least so far as to be more lucrative than meadow or pasture. I omit clover and rye-graſs, because they have been long in general practice; but are in common very short of the advantages which may be derived from the cultivation of the other articles recommended.

There is one other article, however, which is particularly worthy of the arable farmer's utmost care and attention, which he may rely on with great confidence, if he will be at the pains of thoroughly cleaning his land, and of keeping it so for two or three years after it is sown. The article I mean is Sainfoin. From the miserable appearance it often makes the first year, I long doubted if its succeſs in poor land was not very precarious; but I have now the fullest conviction, that it will grow and produce a very good crop in poor land, provided the soil be dry, and proper care be taken to keep it clean till it be fully established in the ground.

Small arable farms, which in a manner are quite destitute of herbage, cannot well be supplied with any substitute that is by any means its equal. Indeed one acre of good sainfoin is of more value than two acres of middling meadow or pasture. And as it will thrive so well on a very poor soil, the arable farmer, who either keeps no cows for want of herbage, or keeping them is pinched for food for them, is perfectly ignorant of the advantages attending the culture of this plant, or miserably indolent and inexcusable in not better attending to his interest.

Whatever crop precedes the sowing of sainfoin, the ground should be ploughed in the winter, and laid up in sharp deep ridges by one bout of the plough, to continue till the beginning of April. Then it should be dragged and harrowed level: and if the land be very poor, it should have some light dreſsing of ashes, soot, or a compost of lime, earth, and rotten dung, well incorporated together. A small quantity of either of these would greatly encourage the plants in their infant state. The beginning or middle of April, as the season may prove, the seed should be sown, and there would be little danger of its succeeding to one's wish.

Perhaps there cannot be a better nor a surer means of cultivating this very useful plant to the greatest advantage, than by sowing it after potatoes. The horse and hand-hoeing them during their growth, and the ploughing, dragging, and harrowing the ground to clean it of the potatoes, so thoroughly destroy the weeds, and pulverize the soil, that it is made in the most perfect condition for a crop of sainfoin; and though the land may in its nature be very poor, the manuring properly for a crop of potatoes, and that being grown perfectly rotten, the soil is become sufficiently fertile.

Besides the above, perhaps there are very few articles in use as substitutes for pasture, that are equally profitable with carrots and parsnips, when the soil is suitable to their manner of growth and culture. The soil they delight and flourish most in, is a deep, light, free soil, which is easily penetrated, and moderately fertile. In such a soil, if properly hoed and set out at due distances, they will arrive at a great magnitude, and the acreable produce be very surprising. Another advantage is, their being so very acceptable to the farmer's stock of every kind. Horses, cows, sheep, and hogs, eat them seemingly with the same appetite, and are equally improved by them. Unfortunately the quantity of such land bears but a small proportion to what is totally unsuitable to them. Hard, stiff, obdurate land, and such as strongly coheres, is quite unnatural to them, and never answers the expense and trouble; what grows in such land being very short, generally forked, and of small value. Potatoes, cultivated as above directed, would, I think, be as good a preparation for those roots as can well be invented. If the soil be well manured for the potatoes, it will be sufficiently fertile for carrots and parsnips, and, lying through the winter in fallow, will be in excellent order for sowing the seeds of these roots the March following.

Upon the whole of this account, it seems clearly to follow, that an arable farm of 50l. or 60l. per annum, though it has not an acre of meadow or pasture land belonging to it, may, by skill and proper management, be made to produce as much and as good butter and cheese, as a dairy farm of the same value, and have a large proportion of land left for the growth of corn and other purposes.

For instance; twenty acres of the sixty, I conceive, would be competent to the maintenance of the stock above mentioned, and they might be fitly divided as follows: viz. Six acres of potatoes, two or four of cabbages, two of turnip-rooted cabbage, and two of turnips, making together twelve or fourteen acres; the remainder to be sainfoin; in all twenty acres. The proportion to be varied, and some articles exchanged for others, as the nature of the soil and particular circumstances might require, and as the farmer might think fit and proper. On twenty acres thus planted, I reckon, besides twenty milch-cows, six or eight young cattle, and pigs in proportion, might be well kept on the offal.

It may be asked, should this plan be generally adopted by the farmer, for whose use it is principally intended, if it would not be running out of one extreme into another? If so considerable an increase of milk, butter and cheese, would not lower the prices of those articles too much, and raise the price of wheat in a greater proportion? That it would lower the prices of these articles is very certain, and it is a very desirable circumstance that it should. At this time, and for six weeks past, butter has been sold in North Bockhampton for nine-pence a pound, and will most probably be sold for ten-pence very soon; whereas, I should hope, the average price might, by the proposed improvement, be reduced to sevenpence.

There is little danger, however, of the price of wheat being advanced by the appropriation of about twelve acres of land annually to the cultivation of the above articles; for the land would be so much improved by the extra tillage given to the soil intended for those articles, and also during their growth, that I am rather of opinion they would produce more corn than if constantly planted in the usual very imperfect manner.

The greatest obstacle to this mode of managing a small farm (say from 20l. to 60l. per annum) is, the confined or narrow circumstances of the occupiers of such farms. In general, their capitals are much too small to carry on their busineſs to any advantage in the present mode of management; but the mode recommended would require an increase of capital to the tune of 200l. or 300l. Leſs than 400l. would not stock a farm in this way of 60l. per annum at any rate; but a capital of 500l. would be vastly more convenient, and indeed much more to the farmer's advantage.

If the improvements proposed are so interesting to the individuals immediately concerned, how very important are its effects in a political view, as it respects the community at large! If eight acres of land, by skill and management, can be rendered as productive and as profitable as forty-eight acres, whose natural produce is of a medium value, it is virtually increasing the extent of territory in a six-fold proportion, for if every acre of land could by art and industry be made to yield six times the quantity of produce it does at present, the whole might be rendered capable of supporting six times the number of the present inhabitants.

But this is far from being the whole of the advantage that will accrue from it. It will not only increase the quantity of provisions as aforesaid, but it will also find abundance of employment for the poor labourer and his family. In this respect dairy farms are in a manner of no use; they afford little or no employment at all for the poor labourers. Within a few miles of me lives a dairy-man, who milks constantly between twenty and thirty cows. He has no wife, keeps only one maid-servant, has neither man nor boy to aſsist him, and only hires a woman in the neighbourhood to aſsist in milking night and morning, for which he pays her 15d. or 16d. per week. This is his whole expense in the management of his dairy; scarce a tenth part of his rent; whereas every arable acre, cultivated with potatoes, &c. as above, will cost four or five times as much as the rent of the land they grow on. What an amazing difference doth this make to the poor of a populous country, and also to those who must either find them employment, or maintain them without any!

I have often employed a poor family in planting potatoes, and also in following the plough, and picking them up when harvested; a man, his wife, and two children, about 12 or 13 years of age. The man I paid 6s. a week, the woman 3s. and the two children 3s. together 12s. A very pretty income for a poor family! At these times they usually got them a few clothes; at other times, when I had no employment for them, they have been often obliged to seek relief from the parish.

It is certainly a matter of great importance to all men in buſineſs, to do all in their power to promote the beneficial employment of the poor; it not only serves to alleviate a burthen, which in many places is become intolerable; but is also the surest means of keeping the poor honest. Many of them, I hope, would never have thought of being otherwise, if they had not been first impelled by neceſsity; who from petty pilferings to get a penny, go on to greater thefts, till they at last arrive at the gallows; whereas, had they been constantly employed, they would have been neither neceſsitous nor idle—the two grand sources of all the evils they suffer, and the injuries they do to society!

# ESSAY XV.

*A Chart of the* NORFOLK HUSBANDRY, *on a light S*
*Fields Arable*

| Fields. | 1778 | 1779. | 1780. | 1781. | 1782. | 1783. |
|---|---|---|---|---|---|---|
| 1. | Turnips, 5 Ploughings. | Barley, 3. | Clover. | Wheat, 1. | Oats, 1. | Turnips, 5. |
| 2. | Barley, 3. | Clover. | Beans, 1. | Wheat, 1. | Turnips, 5. | Barley, 3. |
| 3. | Clover. | Pease. | Wheat, 1. | Turnips, 5. | Barley, 3. | Lay. |
| 4. | Wheat, 1. | Oats, 1. | Turnips, 5. | Barley, 3. | Lay. | Lay. |
| 5. | Oats, 1. | Turnips, 5. | Barley, 3. | Lay. | Lay. | Lay. |
| 6. | Turnips, 5. | Barley, 3. | Lay. | Lay. | Lay. | Wheat, 1. |
| 7. | Barley, 3. | Lay. | Lay. | Lay. | Beans, 1. | Wheat, 1. |
| 8. | Lay. | Lay. | Lay. | Wheat, 1. | Oats, 1. | Turnips, 5. |
| 9. | Lay. | Lay. | Wheat, 1. | Oats, 1. | Turnips, 5. | Barley. 3. |
| 10. | Lay. | Pease, 1. | Wheat, 1. | Turnips, 5. | Barley, 3. | Clover. |
| 11. | Wheat, 1. | Oats, 1. | Turnips, 5. | Barley, 3. | Clover. | Pease. 1. |
| 12. | Oats, 1. | Turnips, 5. | Barley, 3. | Clover. | Wheat, 1. | Oats, 1. |

*being the best regular Course of Crops on a Farm of Twelve Twelve Years.*

| 1784. | 1785. | 1786. | 1787. | 1788. | 1789. |
|---|---|---|---|---|---|
| Barley, 3. | Lay. | Lay. | Lay. | Pease, 1. | Wheat, 1. |
| Lay. | Lay. | Lay. | Wheat, 1. | Oats, 1. | Turnips, 5. |
| Lay. | Lay. | Wheat, 1. | Beans, 1. | Turnips, 5. | Barley, 3. |
| Lay. | Wheat, 1. | Pease, 1. | Turnips, 5. | Barley, 3, | Clover. |
| Pease, 1. | Wheat, 1. | Turnips, 5. | Barley, 3. | Clover. | Wheat, 1. |
| Oats, 1. | Turnips, 5. | Barley, 3. | Clover. | Wheat, 1. | Oats, 1. |
| Turnips, 5. | Barley, 3. | Clover. | Wheat, 1. | Pease, 1. | Turnips, 5. |
| Barley, 3. | Clover. | Beans, 1. | Wheat, 1. | Turnips, 5. | Barley, 3. |
| Clover. | Beans, 1. | Wheat, 1. | Turnips, 5. | Barley, 3. | Lay. |
| Wheat, 1. | Oats, 1. | Turnips, 5. | Barley, 3. | Lay. | Lay. |
| Wheat, 1. | Turnips, 5. | Barley, 3. | Lay. | Lay. | Lay. |
| Turnips, 5. | Barley, 3. | Lay. | Lay. | Lay. | Wheat, 1. |

## *A Chart of the* NORFOLK HUSBANDRY *on a* HEAVY SOIL;

| Fields. | 1778 | 1779. | 1780. | 1781. | 1782. | 1783. |
|---|---|---|---|---|---|---|
| 1. | Turnips.<br>* | Barley. | Clover.<br>† | Wheat. | Oats. | Turnips,<br>* |
| 2. | Barley. | Clover. | Wheat. | Oats. | Turnips. | Barley. |
| 3. | Clover. | Pease. | Oats. | Turnips. | Barley. | Lay. |
| 4. | Wheat. | Oats. | Turnips. | Barley. | Lay. | Lay. |
| 5. | Oats. | Turnips. | Barley. | Lay. | Lay. | Beans. |
| 6. | Turnips. | Barley. | Lay. | Lay. | Beans. | Wheat. |
| 7. | Barley. | Lay. | Lay. | Beans. | Wheat. | Turnips. |
| 8. | Lay. | Lay. | Beans. | Wheat. | Turnips. | Barley. |
| 9. | Lay. | Beans. | Wheat. | Turnips. | Barley. | Clover. |
| 10 | Beans. | Wheat. | Turnips. | Barley. | Clover. | Wheat. |
| 11. | Wheat. | Turnips. | Barley. | Clover. | Wheat. | Oats. |
| 12. | Turnips. | Barley. | Clover. | Wheat. | Oats. | Turnips. |

*being the best regular Course of Crops for Eleven Years.*

| 1784. | 1785. | 1786. | 1787. | 1788. | 1789. |
|---|---|---|---|---|---|
| Barley. | Lay. | Lay. ‡ | Beans. | Wheat. | |
| Lay. | Lay. | Beans, | Wheat. | Turnips. | |
| Lay. | Beans. | Wheat. | Turnips. | Barley. | |
| Beans. | Wheat. | Turnips. | Barley. | Clover. | |
| Wheat. | Turnips. | Barley. | Clover. | Wheat. | |
| Turnips. | Barley. | Clover. | Wheat. | Oats. | |
| Barley. | Clover. | Wheat. | Oats. | Turnips. | |
| Clover. | Wheat. | Oats. | Turnips. | Barley. | |
| Wheat. | Oats. | Turnips. | Barley. | Lay. | |
| Oats. | Turnips. | Barley. | Lay. | Lay. | |
| Turnips. | Barley. | Lay. | Lay. | Beans. | |
| Barley. | Lay. | Lay. | Beans. | Wheat. | |

## EXPLANATION *of the preceding* TABLES.

In the first table, the figures in the squares xpreſs the number of ploughings.

The two crops after the *lays* and *clover*, may be varied according to the season, or the soil, by the discretion of the farmer. And where bullocks are fatted with straw and turnips only, this plan will be more productive of profit to the farmer, and benefit to society, than any other yet discovered; experience having shown, that two hundred acres of land, half in tillage, and half natural graſs, will keep as many cattle as the whole would do all in natural graſs; by this means, therefore, all the produce of corn (labour deducted) is clear gain, and the land cannot be injured thereby.

It is to be noted, that the turnips are twice hoed, and not left nearer than fourteen or sixteen inches to each other; that they must not be fed, but drawn, carted, and given to the bullocks in a straw-yard, or some other place convenient for preserving the manure.

Beans must also be twice hoed, and in very wet seasons three times, if wheat is to follow them.

Pease are an uncertain crop, and often fill the land with weeds.

The two capital crops, wheat and barley, in these tables, come twice in the course,—the turnips twice,—the broad clover only once; by which means the different plants are thrown at such a distance from each other, that (seasons permitting) it is impoſsible to fail of good crops; and the worm, which is produced by frequent repetitions of broad clover, and is certain destruction to that plant and the succeeding crop, is prevented.

This mark * signifies, that from twenty to forty cubic yards of rotten dung per acre is to be laid on immediately before the last ploughing.

This †—that a like quantity of compost, the mixture two parts ditch scourings, mould from borders, or almost any kind of earth, and the other part dung. This should be heaped, and in the course of two years turned over three times, to mix it well, and destroy the weeds. Lay it on the clover in the spring.

And this mark ‡ denotes a covering of marl, eighty cubic yards per acre. The lay is to be fed the last year, so that it may be covered in the interval between hay and corn harvest.

Wheat, after the clover lay, ought always to be *set.*

Wheat stubbles are never ploughed in, but raked up, and carted to the straw-yard.

The expense of marling (carting and spreading included) is reckoned, when the marl is digged in the field, at 3l. per hundred cubic yards, but I have done it for two guineas.

N. B. Six score makes the hundred. Half-load carts, with three wheels, take fewer horses than load-carts, but are worse for the horses.

When the turnips fail, plough the land into yard ridges, water-furrow it well, and let it lie for barley next year. This is excellent husbandry, and greatly preferable to a wheat crop after the fallow.

The best method to preserve turnips from the fly is, to take one pint of new seed, and steep it in water five or six hours, then mix it with another pint of new seed unsteeped, and a pint of seed of the year before; by this method the plants will come up at three different times; and as the fly always seizes the youngest plants, it seldom happens but that enough of each growth will be left for a crop, one pint of seed being sufficient for an acre, could it be properly distributed. In pursuing this method, I never lost a turnip crop.

Turnips, with chaff, and the straw of barley, oats, or pease, are excellent food for horses, provided the straw be fresh threshed, and given to them as they want it.

Galloway Scots, four years old, or almost any beast of that age, taken into the straw-yard in October, and well attended with good straw and turnips, will be fat by the April following. An acre of good turnips is sufficient for a beast of forty stone, fourteen pounds to the stone. The beasts here alluded to, are such as are brought to the fairs in tolerable condition.

# ESSAY XVI.

## *Upon the Insects that prey upon Timber.*

NO part of the economy of this terrestrial globe, is more worthy of admiration, or furnishes a wider field for inquiry, than the methods by which all that vast variety of substances, animal and vegetable, which are produced from the earth, are kept within their proper bounds, and when life is departed from them, are reduced to dust; so that a due harmony of parts is preserved, the relative proportion of individuals accurately adjusted to the wants and general good of the system; and those substances which have a tendency to deform or injure it, are in due time removed out of the way, and made to contribute under another form to its support.

Not to mention Man, and the various species of Quadrupeds, birds, fishes, reptiles, and worms, which prey on animal and vegetable life; insects, although very diminutive, are very powerful instruments, in the hands of the great Disposer of events, to promote, sometimes indeed by partial evil, the good of the whole. To them it is given in charge not only to prey on living substances, but also to hasten the diſsolution and decomposition of those that are dying or dead. Of these none seem to have a more arduous task aſsigned them, than those whose office it is to bring on, or accelerate the decay of the giant inhabitants of the forest. Numerous species of insects, and in various ways, labour in this department *. Some attack living Trees, others those that are dead. Some deposit their eggs in them, that, when hatched, their larva may feed upon the wood; while others seek only a place well sheltered from wet, cold, birds, or other insects, for the habitation of their young. Again, some prey upon the soundest timber; while others make no attempt upon it till it begins to decay:—but all contribute, in one way or other, to the same end; one taking up the office, where another resigns

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* Insects are not the only labourers employed in this field; the same end is promoted by the Algæ and Fungi. Witneſs the numerous tribe of Lichens, Tremellæ, Agarici, Boleti, Auriculariæ, Sphæriæ, &c. which derive their nourishment from decaying Wood, and aſsist in its decomposition.

it; till that which from its bulk and solidity appeared calculated to last as long as the earth that gave it birth, by the ſucceſsive efforts of various kinds of insects, is reduced in no very long time to its original dust. So powerful are the effects produced by instruments which we too often overlook or despise.

To particularize some of the species employed in this work, and to point out what trees they attack either for food, or to secure a sheltered situation for their offspring, may not be unentertaining, or altogether useleſs. I shall therefore mention a few of the individuals of each of the Linnean claſses, omitting Hemiptera and Neuroptera, of which I recollect no species that feed or nidificate in wood; reserving the Coleoptera, which claſs sends forth the most numerous bands of these minute pioneers of nature, to the last; and concluding the whole with a short history of the Cerambyx violaceus of Linnæus.

Among the Lepidopterous insects, the larva of the Phalæna Bombyx Coſsus is known to attain its great size by feeding upon the Willow, and other kinds of wood when in a decaying state. The same tree affords nourishment, as we learn from Mr. Lewin *, to the Sphinx crabroniformis; as does the Poplar to the Sphinx apiformis †, and vespiformis. The insects of the Hymenoptera claſs bring on the decay of ligneous substances in various ways. The nests and cells of many of the genuine Vespæ are made of a kind of paper formed of the filaments of wood. I have often been highly amused by seeing the common wasp, which though a mischievous, is at the same time a very ingenious animal, employed in scraping gate-posts with her strong maxillæ, to collect materials for this purpose; a sight which Reaumur informs us it was long before he could enjoy ‡. The Hornet frequently perforates hollow trunks to build her paper metropolis in a sheltered situation ‖. The Leaf-cutter bees, of which

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* Linn. Trans. vol. iii. p. 2.

† Ibid. p. 1.

‡ Reaum. Tom. vi. Mem. 6. p. 180, 181.

‖ Ibid. Mem. 7. p. 217. I am informed by my friend, Sir Thomas Cullum, whose spirit and accuracy of observation throw light upon every branch of Natural History, that in the year 1785, in Mr. Porte's gardens at Ham, near Dovedale, the hornets destroyed a great number of the young Oaks, by making their way into their heart, and there building their nests.

there are several species all confounded under the common name of A. centuncularis, in order to place their centunculi [*] of curious construction, in perfect security, make their way into the body of various trees. One species selects the Willow for this purpose [†], another the Oak [‡] or the Elm indifferently. Apis maxillosa [||] nidificates in posts and rails. Apis violacea, as we learn from Reaumur [§], constructs curious cells for its young, of several stories, in the supports of espalier trees. Apis furcata [¶] makes similar cells in decaying wood. Many other insects of this claſs, particularly Spheges, and illegitimate Vespæ, emerge from cylindrical holes in trees and posts, in which they were nourished in their larva state.

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[*] Ibid. Mem. 4. Tab. 9. fig. 8.—181. Tab. 10. Reaumur's species make its nest under ground; but Geoffroy's (Hist. ab. des. Ins. Tom. ii. p. 410. n 5.) and our English ones make theirs in the trunks of trees.

[†] Raii. Hist. Ins. p. 245. Sir E. King, in Philos. Trans. abridged by Lowthorp, vol. ii. p. 773. Willoughby in do. p. 773. 774. Dr. Martin Lister in do. 774.

[‡] Apis centuncularis, Donovan Brit. Ins. vol. iv. Tab. 120.

[||] Marsham in Linn. Trans. vol. iii. p. 27, 28.

[§] Reaumur, Tom. vi. Mem. 2. Tab. 5.

[¶] Furcata. A. cinereo pubescens; atra; antennarum articulo primo, fronte, labioque flavis; abdomine apice furcato; tarsis ferrugineis. Panzer. Fn. Ins. Germ. Init. No. lvi. Tab. 8. Obs. Panzer's insect is the male of this species.

Of Dipterous insects, the Tipula Pectinicornis, singular for the branching antennæ of the male, and many other species of that genus, in their larva state, inhabit putrescent wood * : and a numerous army of the Oniscus Asellus, to name no other insect in the Aptera claſs, is generally to be met with in those parts of decaying trees under the bark, which are deserted by other insects; upon which, from its saw-dust-like excrement, it appears to feed.

Having gone over the other claſses, it remains that we mention the devourers of wood amongst the Coleoptera. Foremost in the ranks comes the gigantic Lucanus Cervus, whose larva feeds upon the decaying wood

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* Habitat in carie arborum solitaria larva, pupaque. Schrank. Enum. Ins. Austr. p. 423. n. 853. I have found the pupa in the same situation.

of the Oak [†] and the Elm. In the latter is also found the Lucanus Inermis [‡]. The Ash affords nourishment both to Lucanus Parallelipipedus and L. Cylindricus. (Scarabæus Cylindricus of Linn. but surely a true Lucanus.) The several species of the genus Ips (Bostrichus Fab.) feed upon timber between the bark and the wood, upon the surface of which they usually trace in feeding, what Linnæus calls Pinnated Labyrinths, in which a number of lateral lines, nearly parellel with each other, form right angles on each side, with a central one; and thus the bark is finally separated from the wood. Most trees, I imagine, have a particular species of this genus aſsigned to them. Thus Ips Piniperdus attacks the Fir. Ips Scolytus, the Elm. Ips Niger [‖], I. Griseus [§], I. Rufescens [‡], and, I believe, I. Nebulosus [||], undertake the barking of the Ash. Ips Fuscus [§], and probably more species, feed upon the Oak. Even shrubs do not escape, for whin, or furze, (Ulex Europæus) is preyed upon by the minute Ips Rhododactylus [¶], which I have frequently taken coming out of the larger sticks of a dead whin fence in my own garden. Next to these come the Ptini; several species of which are found in wood. I meet with Ptinus Teſsellatus in the Willow, and I believe it will attack deal, or any soft wood. It is one of those insects that is called the Death Watch, from a certain sound which it makes at regular intervals resembling the clicking of a watch, which the vulgar superstitiously imagine forbodes the death of some person in the house in which it is heard. The Ptinus Pectinicornis also, and Pt. Cylindricus*, feed in the same tree. But of all the species of this genus, Ptinus Pertinax is the most mischievous; any kind of wood that begins to have a tendency to decay, it attacks without mercy. I speak this from experience, having a chamber in my house, the floor of which is quite filled and perforated in every direction by this destructive little insect; and my walnut-tree chairs it has nearly reduced to the same state that Linnæus observes it has done his †.

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[†] In Europæ ligno quercino putrido. Linn. Syst. Nat.

[‡] Inermis, 2. Scutellatus, convexus, brunneus, maxillis, brevibus, dente laterali elevato. Marsham M. S.

[‖] Niger 24. I. subcylindricus, niger, thorace punctulato, elytris crenato striatis, plantis piceis. Marsham, M.S.

[§] Griseus. 9. I. ferrugineus, capite nigro, supra ferrugineo testaceoque varius. Ibid.

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[‡] Rufescens. 10. I. subtus luteus, supra rufus, elytris luteo nebulosis. Ibid.

[||] Nebulosus. 8. I. subvillosus, corpore nigro cinereoque vario. Ibid. Bostrichus Fraxini: ater fusco cinereoque varius, elytris punctato striatis, antennis testaceis clavâ cinereâ acutâ. Panz. Fn. Ins. Germ. Init. n. 16. Tab. 63.

[§] Fuscus. 5. I. fuscus, antennis pedibusque testaceis: elytris retusis confertius punctulatis. Marsham, M. S.

[¶] Rhododactylus. 22. I. niger, villosus totus, plantis rufis. Ibid.

Amongst the Curculiones, the late ingenious Mr. Curtis has informed us, that C. Lapathi feeds upon the Willow ‡. C. Lignarius §, preys upon the trunk of putrid Elms; and

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* Cylindricus. 6. Pt. subcylindricus fusco ferrugineus; thorace gibbo læviusculo; antennis pedibusque rufescentibus. Marsham, M. S.

† Terebravit et destruxit sedilia mea. Linn. Syst. Nat.

‡ Linn. Trans. vol. i. p. 86.

§ Lignarius. 113. C. nigro piceus totus, rostro crassiusculo, thorace punctato, elytris abbreviatis. Marsham, M. S.

C. Atramentarius* I have found in all its states in old rails under bark. There is one insect, which although not yet discovered in England, ought not to be paſsed over, as its history furnishes a striking proof how useful the study of natural history may be made, when applied to economics; the insect I allude to, is the Cantharis Navalis of Linnæus. Dr. Smith, the liberal poſseſsor of the Linnæan treasures, informs me, from the Iter Westrogothicum, that the oak timber in the royal dock-yards in Sweden being observed to have suffered considerable injury from some unknown animal, Linnæus was desired by his Swedish Majesty to trace out the cause, and point out some remedy which might prevent the further progreſs of so alarming an evil. Upon inquiry, he discovered that the mischief was occasioned by this Cantharis, and he recommended that the timber should be immersed in water during the usual time of this insect's appearance. This advice was pursued, and the dock-yard timber received no further injury.

We have so few species of the genus Buprestis in England, and those that we have are so seldom met with, that it is no wonder if the habitation of their larvæ is not commonly known; both De Geer* and Geoffroy†, however, are of opinion, that they are inhabitants of wood. But the timber-merchant and the builder have no greater enemies than the genuine Cerambyces, under which genus I would, with De Geer‡, include those only which have reniform or lunar eyes, excluding C. Cursor, Lamed, Meridianus, Inquisitor, &c. and taking in Leptura Alni, Arcuata, Arietis, Mystica, Præusta, &c. of Linn. These insects, as far at least as we are acquainted with them, not only devour the surface of the wood that lies under the bark, but penetrate deep and in all directions into the solid timber. What havock must the larvæ of so large an insect as Cerambyx Coriarius make in an oak tree‖! I have taken the pupa of Cerambyx Arcuatus out of the heart of a solid piece of the same timber, which had been perforated by that insect in all directions. Once in the height of summer, when the mid-day sun shone out warm, I was very much entertained with seeing several of these fine insects fly down upon a pollard oak that had been felled and the bark left upon it, and run all over it with great velocity, seeking, it is probable, a place proper for depositing their eggs.

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* Atramentarius 165. C. ater obovatus, thorace utrinque unidentato, elytris striatis. Ibid.

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* De Geer, tom. iv. p. 131.

† Geoffr. tom. i. Cucujus n. 1. p. 125. n. 2. p. 126.

‡ De Geer, tom. v. p. 55, 56.

‖ Habitat in betulis putridis. Linn. Syst. Nat. But I have known it cut out of an oak.

Amongst the Cerambyces of this country, the ingenious Mr. Donovan, in his elegant work upon British insects * has figured C. Violaceus, and informs us that it probably feeds upon the fir, but at the same time expreſses a strong suspicion that this beautiful insect is not originally English. How far this may be true, it is not my intention to inquire; I shall only observe, that it is now become but too common, at least in one spot, in the neighbourhood of London, as will appear from those circumstances of its history which I am going to relate.

My friend and relation, Mr. James Trimmer,

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* Donov. Brit. Ins. Vol. 2. p. 73. Tab. 61. fig. 1.

of Old Brentford *, an attentive observer of Nature, more particularly of the economy and habits of insects, and to whom I am indebted for much curious and interesting information in this branch of science, some time ago wrote to inform me, that he had found this insect in its three states in fir-timber, and accompanied this intelligence with many ingenious remarks. Expecting him soon to visit me at Barham, in my answer I requested him to bring with him some of its larvæ and pupæ, and also some pieces of the wood upon which they had been feeding; at the same time I desired him to continue observing their motions. What follows relative to the history of this Cerambyx, is chiefly compiled from his communications, which I thought too interesting to be lost. The fir in which Mr. Trimmer first found this insect, was of English growth, of the spruce kind, which had not been felled many years, and had originally grown near the spot on which the building was erected, in which it was employed: it did not appear to have been

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* Son of Mrs. Trimmer, so justly celebrated for her humane and succeſsful exertions to procure the great bleſsing of a religious education for the children of the poor.

attacked more than two years when Mr. Trimmer made his observations; and it suffered most in 1798, when the larvæ had multiplied so much, and been so extremely voracious, as to have left very little food for another year. Some Scotch fir, in an adjacent building, had also been attacked by them. Nor does this insect so intirely confine itself to fir, as never to attack any other kind of wood; for when the imago first came forth in considerable quantities, Mr. Trimmer took several and placed them upon some pieces of fir which were under cover: but what seems remarkable, the insects quitted these, and went and deposited their eggs in some pieces of apple, pear, cherry, and plum, which had been selected for turning, and were piled up in the open air.

It is worthy of observation, that this destructive little animal attacks only such timber as has not been stripped of its bark; a circumstance which ought to be known and attended to by all persons who have any concern with this article; for the bark is a temptation, not only to the insect in question, but also to a numerous tribe both of this and other genera; and a great deal of the injury which is done to timber would be prevented, if other trees, besides the oak, were barked as soon as they are felled. The principal danger, however, arises from neglecting this precaution with respect to such timber as is used in buildings; especially in those places that are acceſsible to insects, for in this case it will not last out half its time.

But, to proceed with our history, the female of this insect is furnished with a flat, retractile tube, or rather aculeus *, which she inserts, it should seem, (for Mr. Trimmer was never so fortunate as to see this operation performed,) between the bark and the wood to the depth of about a quarter of an inch, and there she deposits her egg, since not more than one appears to be laid in one place. By stripping off the bark, it is easy to trace the whole progreſs of the larva, from the spot where it was newly hatched, to that where it has attained its full size †. At first it proceeds onwards but in a serpentine direction, filling the space which it leaves behind it with its excrement, resembling

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* Tab. 12. fig. 15. *C.* Linn. Trans. vol. v.

† Fig. 13. *a—c.*

saw-dust, and so stopping all ingreſs to enemies from without; but when it has arrived at its utmost dimensions, it does not confine itself to one direction, but works in a kind of labyrinth, eating backwards and forwards, which gives the wood under the bark a very irregular surface*; by this means its paths are of considerable width. Its attacks are not confined to the solid timber, but in its progreſs it eats away an equal portion of the bark. The bed of those paths where it has been at work, exhibits, when closely examined, a curious appearance, occasioned by the erosions of its maxillæ, which excavate an infinity of little ramified channels. When the insect is about to aſsume the pupa, it bores down obliquely into the solid wood, to the depth sometimes of three inches, seldom if ever leſs than two. These holes† are nearly semicylindrical, expreſsing exactly the form of the grub. One would wonder how so small and seemingly so weak an animal could have strength to excavate so deep a mine: but when we see its maxillæ, our wonder ceases; these are large, thick, and solid sections of a cone divided

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* Tab. 12. fig. 14. Linn. Trans. vol. v.

† Fig. 14. *a, a, a.*

[illegible] in the act of masti-
[illegible] ther the whole of their
[illegible] so that they grind the
[illegible] like a pair of mill-stones.
[illegible] the larvæ, except some
[illegible] served to have entered the
[illegible] some began so soon as
[illegible] place in the bark opposite
[illegible] imago gnaws its way out of
[illegible] makes its appearance, which
[illegible] the 20th of May, and con-
[illegible] the 20th of June, it returns
[illegible] which the larva had ex-
[illegible] to aſsuming the pupa.
[illegible] thinks that these insects fly only
[illegible] as in the day time he always
[illegible] upon the piece of wood
[illegible] had been disclosed. The
[illegible] Cerambyx arcuatus,
[illegible] before, flies at mid-day:
[illegible] circumstance may depend
[illegible] of the atmosphere, or the
[illegible] many insects have their
[illegible] a singular instance of
[illegible] opportunity of witneſsing.
[illegible] July, 1798, about ten

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[illegible] Trans. vol. v.

o'clock in the morning, as I was paſsing through a meadow, I was surprised with the appearance of what at first seemed to me to be myriads of bees flying about the hedges and trees; but upon taking some of them, they proved to be Scarabæus argenteus; (Melolontha argentea Fab.) upon my return through the same field, a little after noon, I was astonished to find that of this infinite host of insects not a single one was to be seen.

I have now communicated all the observations which Mr. Trimmer made with respect to the history of this insect; these I hope will not be thought unworthy of the attention of the Public, since they furnish an useful leſson in Economics, and supply an additional proof of the utility of the study of Natural History, and to what good purposes it may be directed.

# ESSAY XVII.

## *On the Cultivation of Willows.*

I WOULD first advise the laying out the ground into lands, like hop lands, viz. from three to four yards wide, with a ditch on each side; three feet wide at the top, one foot at the bottom, and two and a half deep. The earth that comes out of the ditch should be thrown on the land. But if there is not full sufficient fall for the water to get off, the ditch should be deeper and wider, till you have near a yard of earth above the level of the water.

As soon as this is done, the ground must be double dug, viz. trenched two spades depth, except your ground be very boggy, which will afford room for the plants to shoot, and will save the expense of weeding, which otherwise must be incurred in the first summer after the plants are set; for if they are not kept clear of weeds the first year, the hopes of the planter will certainly be destroyed.

The willow I recommend as most advantageous on every account—is the broad-leaved red-hearted Huntingdonshire willow; every other species I have tried, and find reason to give a decided preference to this.

The sets, or truncheons, may be cut from twenty inches to two feet long; particular care should be taken in the cutting, that the bark should not be fridged or bruised, or in any other respect injured; for in that case the plant will be weak and puny. They should be cut not on a block, but in the hand; obliquely and with a very sharp bill, or instrument. They must be dibbled into the earth by an iron crow, to the depth of fourteen or twenty inches, so that not more than six, or leſs than four, appear above. If the truncheon should not fill the hole, the earth must be trampled close round it, in order that the air may be excluded. Care must be taken that the plant be set as the pole grows. The cuttings should be from poles of about three years growth. Maiden poles are the best; they should be set three feet asunder in the quincunx form, as thus:

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Those truncheons will shoot out many branches, two or three of which will grow to poles, if the land is good; if not, only one. Those poles I have sold, at eight years growth, for 214l. per acre, neat money; the kids, or brushwood, pay for the felling. Had I suffered them to have stood two years longer, they would have produced 300l. per acre. Should any of the plants look weak or puny, or not shoot vigorously, it will be neceſsary to dig in a skuttle full of manure, to the roots, which I have no doubt in saying will pay.

Though I have planted no leſs than ten acres, I cannot say positively, from my own knowledge, what the value would have been had they remained on the ground for fifteen or twenty years, having been called on for sets by the gentlemen of the neighbourhood, which I have sold for three pound a thousand. I must here observe, that the stools from whence the sets are cut, shoot very luxuriantly, and will produce from three to four poles.

The length of poles, at eight years growth, were from thirty-three to thirty-six feet, and and most of them were large enough to make three rails, two at the bottom and one at the top; but the great use to which they are applied, is for the purpose of making hurdles, flakes, gates, and other farming implements, being a wood uncommonly tough and light, owing, as I conceive, to a new method I made use of in planting them close to the ground. If it is the design of the planter to let them grow into timber, (which I would venture to say would be far superior to *deal* for the purpose of flooring, or other light work, particularly as it will neither splinter nor fire; and if suffered to remain for twenty or twenty-five years, would make good masts for small craft, as they shoot up perfectly straight, and without any collateral branches) it is neceſsary, at the first or second year's growth, to observe which pole is the strongest, as the remaining poles must be cut away. In about fifteen years time, I am led to suppose, they will want thinning: of course the inferior must be taken out, and the superior be suffered to remain.

The times of planting must be from January to the end of March; but the sets for that purpose should be cut from December to the end of February, when the sap is down. And the reason is, that if poles are cut in the spring, (the sap being up) the stool will at last be weakened by bleeding, if not killed; and of course prevented from shooting so vigorously as if cut at the preceding time. If, however, there are people so injudicious as to sell sets in spring, it will be to the advantage of the purchaser to plant them, as the sap is then in the poles. The reason why many are induced to cut poles at that time, is on the supposed account of their peeling better; but I can affirm from experience, that poles cut in December, January, or February, and laid in rows upon the ground, or the ends put in water, will peal as well in the spring as at the usual time.

In regard to fencing, the planter should pay the greatest attention to it, otherwise his time and expense will be fruitleſs.

# ESSAY XVIII.

## *On the Conversion of Graſs Lands into Tillage.*

HAVING generally about three hundred pounds a year in my own hands, all dry, and upon a lime-stone, or gravel, I wish my observations to be considered as respecting lands of that quality.

The best method I ever found of converting graſs land into tillage, is unquestionably by paring and burning: you get into a good course of husbandry at once, turnips, barley, &c. &c. and it is a mere chimera to suppose that the soil is diminished by it. I have myself pared and burned the same field twice in the course of fifteen years, and could never discover that the soil was in the smallest degree diminished by the operation. The earlier in the season the weather will admit its being done, the better; the month of May will do very well. When the ashes are spread, the field should be ploughed *true*, but *shallow*, in order not to bury the ashes too deep, then [illegible] fine, and ploughed [illegible] this with a second good [illegible] and incorporate the soil [illegible] that it is hardly poſsible to [illegible] if any rain at all falls [illegible] June.

[illegible] it a rule, and recommend [illegible] all means to eat on the [illegible] the crop with sheep and [illegible] will often make pretexts to [illegible] but I never suffer it, though [illegible] done by stealth.

[illegible] which answers well the [illegible] meadow, feeding, and [illegible] colour, and is never [illegible] recommend the convert- [illegible] as I am fully persuaded, [illegible] over to a tenant to [illegible] nine years, let the [illegible] take what care and pre- [illegible] will not for many years [illegible] was formerly.

[illegible] ably, in most estates, [illegible] quality, moſsy, hide- [illegible] These being previously drained, if they want it, may be taken up for tillage, under articles prescribed by the landlord, and signed by the tenant for the term of eight or nine years; and if the south country farmers resemble ours, it will require some sharp attention to see those articles fully and justly performed.

The crops I recommend, are turnips eat on the ground—barley or oats—pease or beans—wheat: after which the land to be limed, according to the proportions used—we only use a chaldron and a half here, and it works well in *fresh* land, which will produce turnips, barley, beans, and with them I recommend the sowing graſs-seeds. If I did not wish the land to be ploughed any longer than seven years, a wheat crop after the beans would, in my opinion, exhaust the land too much, to sow it down with graſs, unleſs it underwent a further preparation.

I will now give the farmer the result of my experiments in laying land to graſs. I have practised three ways: The first and the most common is to sow the graſs-seeds with the barley, and I have known it answer very tolerably; but I am forcibly struck with the idea, that as barley after turnips is generally a large crop, and takes its nourishment from near the surface, it must naturally hurt the graſs materially, which takes it from the same depth. To obviate this, I sowed a field of four acres of good strongish loam with beans, but not full seed. With this I sowed twelve bushels of good hay-seeds, twelve pounds of white clover, four pounds of trefoil, and two pounds of rib-graſs. The beans not being too thick sown, did not rob, but sheltered and nourished the graſs, and it answered beyond my expectation. I pastured it afterwards for four years, and this measure I strongly recommend. I manured it over once before I suffered it to be mown. It is now as good meadow as any I have, and has laid to graſs fourteen years. My third trial was on a field of ten acres, which had been run out and abused by a very bad tenant. I gave it a complete winter and summer fallow, limed it and prepared it in every respect as if for wheat, and on the 1st of August, after harrowing it long-ways as fine as poſsible, I sowed it with the same proportion of seeds as above mentioned, and brushed it acroſs with a brush-harrow, rolling it over with a light wood roller. This field looked green before Martinmas, and by the middle of April was a good pasture; I did not however turn into it till May-day, when it was very fine. I pastured it, as in the former instance, for four or five years, and it now lets to a tenant as high as any field in my estate. I prefer this method to either of the others; and though tenants will not relish sowing without corn, I recommend the practice to every gentleman who is engaged in farming.

I recommend it strongly to gentlemen to procure the seeds themselves, of the best kinds; but the tenant should pay for them.

It is difficult to form a judgment what addition of rent may be laid on for the permission of taking up fresh land, without knowing *what* crops, and what number of crops, the landlord will allow. The tenant's greatest expense will be one pound five shillings an acre for paring, burning, and spreading the ashes; the subsequent three years will be only seed and labour. From these data, added to a knowledge of the qualities of the land, it will be no difficult thing to judge of the farmer's profit, and what advantage the landlord should receive from it.

# ESSAY XIX.

## *On the Analogy between Vegetable and Animal Parturition.*

When the enlarged philosopher takes a survey of the construction of the heavens, his mind is impreſsed with an awful idea of the power and majesty of the Deity; and he bends in silent reverence. But the philosopher who views him through the medium of his leſser works, forms to himself a closer and more pleasing connection. With a view to recommend the cultivation of this harmonious intercourse, I shall describe and illustrate a subject that, as far as I know, has not been noticed by naturalists: It is the analogy between vegetable and animal parturition.

Fig. 1. Represents an ear of wheat confined in the folium vaginans, or uterus, and within a few days of delivery. *a*. The os uteri, *b*. *b*. The gravid uterus, the mouth of which is, at this time, sealed up to keep out the dews and rain.

Fig. 2. The uterus cut open, to show the ear in its natural situation. *a.* The os uteri. *b. b.* The uterus cut open. *c.* The ear.

Fig. 3. An ear of wheat after having paſsed through the os uteri. This may be called a natural birth. *a.* The ear. *b.* The os uteri. As the fibres of the vegetable os uteri are incapable of distention, the ring is wisely divided to allow a paſsage for the ear without laceration. *c. c.* The uterus.

Fig. 4. An ear of wheat some days after a natural delivery. *a.* The ear. *b.* The uterus contracted to its natural size.

Fig. 5. An ear of wheat after having forced its way through the side of the uterus, the neck being rendered impervious in consequence of being bent down by the action of the wind. This may be called the Cæsarean operation; but which, from the peculiar structure of the vegetable uterus, is not attended with danger. *a.* The os uteri. *b.* The neck of the uterus, bent down by the action of the wind, and consequently rendered impervious. *c. c.* The uterus. *d.* The ear, delivered in a preternatural way.

Fig. 6. An ear of wheat in the act of forcing its way through the side of the uterus. *a.* The os uteri. *b.* The neck of the uterus, bent down by the action of the wind. *c.* The ear forcing its paſsage laterally through the side of the uterus. *d. d.* The uterus.

On a careful examination, we find the uterus made up of a broad leaf, folded up into a tubular form, so that by a gentle lateral preſsure of the ear it is easily unfolded. Had it been a perfect tube, parturition could never have been performed, without laceration, in cases where the neck of the uterus was bent down by external violence. This is a wise provision of the Author of Nature, to obviate frequent and unavoidable accidents. And here it will be proper to remark, that the birth of the ear, or husk, is previous to conception, the antheræ and stigmata being at that time as unformed as the generative organs of an animal at its birth. It is in this manner that God has thought proper to discover to our senses much of his providence; and to encourage our researches, he has endowed us with a most ardent desire to trace him along the path that he has made. And here I cannot refrain from observing, that a proper combination of the study of Nature with revealed religion, will give a dignity to man, so as to enable him to look down with contempt on those metaphysical opinions that have a direct tendency to disturb his happineſs and pervert his judgment.

## ESSAY XX.

### *On the Nature of Soils.*

AS a knowledge of the different soils is of great importance to the farmer, an inquiry into, and description of their nature and properties, so far as relates to the great purposes of vegetation, seems to claim our first attention, and to be the ground-work of Agriculture

Without descending to those nice distinctions, which are rather subjects of curiosity to the philosopher, than of use to the farmer, we may rank all our varieties of soil under the following heads:

Sand, Gravel, Loam
Clay, Chalk, Marl.

By different combinations of these substances, all the intermediate kinds of soil are formed; and upon a proper mixture of them, in certain proportions, depends the general fertility of the earth, and the succeſs of the farmer's labour.

In the nature of soils, the two extremes are, tough wet clay, and loose dry sand. Each of these has its peculiar plants, which will not grow in the other, although they are few in number, and of little known use. But the plants common to both these soils will grow and thrive better in loam, which is a middle species of earth composed of these two extremes, partaking equally of the good qualities of both, without the bad ones. For this reason, lands which partake of the different properties of clay and sand, or which, in other words, are a kind of compound wherein the properties of clay and sand are so united as to correct each other, are generally the most fruitful, and produce the greatest maſs of vegetables. This will more evidently appear, if it be considered in what manner plants and vegetables are nouriſhed, and what it is that gives them bulk, vigour, and firmneſs.

When the seeds, or plants, are depoſited in the earth, certain degrees of warmth, air, and moiſture, are neceſsary for the expanſion of their veſsels, and the extenſion and firmneſs of their fibres and ſolid parts. For theſe purpoſes stiff clay, and looſe ſand, are both, while ſeparate, very unfavourable; the former, by the cloſeneſs of its texture, retains the water like a diſh, admits too little heat or air, and prevents the tender fibres of young plants from ſhooting freely to ſuch diſtances as are neceſsary for obtaining a ſufficient quantity of proper nouriſhment. The latter, (ſand) from the looſeneſs of its texture, admits heat too freely, and is not capable of retaining a ſufficient degree of moiſture for the purpoſes of vegetation. The particles of vegetable nutriment are either abſorbed by the heat, or waſhed down by the rains too low for the roots of plants to reach them. Hence few plants will come to maturity on mere ſand, except ſuch as extend their roots very deep, and attract nouriſhment from a ſtratum below it.

All sands are hot and dry—all clays cold and wet; and therefore the manuring sandy lands with clay, or clay lands with sand, is the best of all, for this changes the nature of the land itself; whereas dung, and other substances, afford only an inferior and temporary improvement. Mixed soils, which incline to the clayey kind, are best of all for corn and pulse. But it is not the natural soil only that the farmers ought to consider, but the depth of it, and what lies immediately underneath it. For if the richest soil is only seven or eight inches deep, and lies on a cold wet clay or stone, it will not be so fruitful as leaner soils that lie on a better under-stratum.

Gravel is perhaps the best under-stratum to make the land prolific.

The best loams, and natural earths, are of a bright brown, or hazely colour. Hence they are in this county called hazel loams. They cut smooth, and tolerably easy, without clinging to the spade or ploughshare;—are light, friable, and fall into small clods, without chapping or cracking in dry weather, or turning into mortar when wet. Next to these, the dark grey, and ruſset mould, are accounted the best. The worst of all are the light and dark ash-coloured.

The goodneſs of land may also be very well judged of by the smell and the touch. The *best* emits a fresh pleasant scent, on being dug or ploughed up, especially after rain; and being a just proportion of sand and clay intimately blended, will not stick much to the fingers on handling. But all soils, however good, may be impoverished, and even worn out by succeſsive crops without rest, especially if the ploughings are not very frequently repeated before the seed is sown.

The famous Mr. Tull, indeed, carried his idea of the advantage of repeated ploughings to such a height, as to suppose they would supply the place of manure entirely. This was doubtleſs an error; but an error which men are very liable to fall into from their warmth in supporting a favourite hypothesis. Repeated ploughings, however, are an excellent method of rendering land sweet and fertile, by destroying the weeds, and exposing all its parts to the kindly influence of the sun and air, by which means it attracts a larger quantity of nutriment from the atmosphere.

If we examine tracts of land which have not been cultivated, we find nature has adapted different kinds of plants to most of the distinguishable varieties of soils; and although some belonging to *one*, may from some cause or other be found on lands of a different quality, they seldom thrive, or perfect their seeds, so as to become general.

Mr. Tull thinks that the only difference in soils, except their richneſs, is occasioned by the different degrees of heat and moisture that they receive; and that *earth*, of whatever kind it be, is equally proper for the production of plants in general, provided the heat and moisture be equally adjusted. But in this I am inclined to think Mr. Tull is mistaken.

His instance that rushes, when taken from a low watery ground, and planted on a dry hill, will grow and flourish there, provided plenty of water be given them, does not prove his position: For in this case, by the addition of water, the state of the soil is changed, and becomes similar to that from whence the rushes were taken, and which is natural to them.

There is (as I before observed) a specific difference of soils, and of the plants naturally growing in each.

The great care of the farmer ought therefore to be, by proper mixtures, to reduce his land to that state and temperament in which the extremes of hot and cold, wet and dry, are best corrected by each other; to give them every poſsible advantage flowing from the benign influences of sun and air; to adopt such kinds of plants as they afford in this state the greatest nourishment to; and to renew their fertility by a judicious allowance of the most proper manures. Where these things are done, there are few spots so unfriendly to cultivation as not to repay his expense and labour with a plentiful increase: But without these, the best tracts of land will in time become a barren waste, or produce little but weeds.

# ESSAY XXI.

## *On Lime.*

THE effect of lime and other calcareous substances upon vegetation is, perhaps, one of the most valuable and extraordinary discoveries that Agriculture has to boast of. It is hardly poſsible for the wildest imagination to conceive a proposition apparently more absurd, than that of taking a piece of the hardest stone, or marble, burning it till completely calcined, throwing cold water upon it, with a view of reducing it to a white powder, and expecting from the effect of that powder, when mixed with the soil, a luxuriant crop of grain, of graſs, or other vegetable production; and yet, when properly applied, the effect is unquestionable.

The beneficial effects of lime in particular, either when applied alone, or used in conjunction with other substances, entitle it to the highest notice. Many different, and even opposite opinions, have been entertained upon the manner in which it operates, few of which are completely satisfactory. It is known, from experience, to produce bulky luxuriant crops, upon lands formerly of little value; but from the barrenneſs that frequently succeeds these bulky crops, lime has been thought dangerous, by stimulating the soil overmuch. Indeed if great care is not taken, after a few exhausting crops, it will be in a worse situation than it was before the application of the lime.

The principal points to be attended to in the lime husbandry, are the following:

1st, To ascertain the quantity proper for each soil.

2d, The mode of applying it, so as to insure the utmost benefit from its use.

3d, The way of preparing it previously to its being laid upon the soil.

4th, The proper rotation of crops to be afterwards followed, so as to preserve the land in a state of fertility.

With regard to the first of these points, namely, the quantity neceſsary for the different soils, we cannot presume to fix it, as that can only be determined by experiments carefully made; but though we decline mentioning the precise quantity proper to be used in all the different situations, we imagine that a general rule may be laid down, which, if carefully kept in view by practical farmers, will, in proceſs of time, lead to the establishment of a standard.

In general it may be observed, that the greatest quantity of lime should be used upon the deepest and richest soils, and the least upon those that are thin and light; leſsening the quantity gradually from the strongest clay to the lightest gravel. Intelligent farmers will at once observe the justice of this remark. Upon strong clays and deep loams, there is a substantial body for the lime to operate upon, containing abundance of rich substances, and consequently a considerable quantity will be required to pervade and give due activity to the whole; but in proportion as the soil grows lighter, the quantity employed must be leſs, and the after-management, with regard to crops, extremely cautious. In short, the most trifling difference in the qualities and consistency of the soil, ought to be a matter of serious consideration with the husbandman, gradually leſsening or increasing the dose, as circumstances may require. In liming a single field, this attention will often be found neceſsary, particularly if the surface is unequal. The soil of the higher parts will, for the most part, be found light and free; while that of the lower is deep and compact. It is obvious, that if a field of this description is limed, and the same quantity laid over the whole, if the quantity is small, the higher parts only will be benefited, while the strong deep land will scarce receive any advantage. On the contrary, if the quantity is great, the higher land will be over-limed, while that below will hardly have enough. To some farmers these may be thought nice, perhaps trifling distinctions; but we trust that, by every judicious man, they will be considered as important. It is seldom that we have seen sufficient attention paid to this circumstance: on the contrary, be the difference of soil what it will, and in large fields it is often very great, we, for the most part, see the same labour bestowed, and the same quantity of lime and other manures laid over the whole. The consequences attending such management do not require to be pointed out.

To do justice to this part of the subject, notice should be taken of the neceſsity of laying out land in such a way as to have the whole field, as nearly as poſsible, of the same quality. Where this is attended to, much difficulty and loſs will be avoided, both in manuring and fixing the rotation of crops.

We cannot take leave of this part of the subject, without earnestly recommending it to every farmer to make himself thoroughly acquainted with the nature of his land, before he ventures upon the use of lime. On some soils, indeed, he will find it totally inadmiſsible, particularly where the bottom is chalk, limestone, or marl; in all of which it will be pernicious, especially if the soil is thin. In such situations, a judicious farmer, in place of laying out his money upon lime, which will not only be lost, but do mischief, will employ it in purchasing enriching manures, which will afford him an ample return.

In perusing the Reports of the different counties throughout the kingdom, we find lime applied in a variety of forms. To detail the whole of these practices would be incompatible with the bounds of this paper; we shall therefore notice only the modes that prevail most, and are practised by the best farmers, who, in general, use it in one or all of the following ways:

1. Upon fallows, for wheat or barley.
2. Upon turnip land.
3. Upon clover ley for oats.
4. As top-dreſsing upon wheat, &c.

1. *Lime upon Fallows.*—When lime is applied upon fallows, it is found to produce the best effects when laid on early in the season, and thoroughly incorporated with the soil. For that purpose it should always get at least two or three furrows, and a complete harrowing with each. By this treatment it will be thoroughly incorporated with the soil, and will operate equally upon every part of it; so that the farmer will reap the benefit of it the first year; whereas, by laying it on only before the last furrow, without harrowing, a great proportion of it will be buried, much of the soil will never come in contact with it, and very little advantage will be derived from it the first year; and when the land is ploughed for the succeeding crop, in place of being able to bring up the whole of the lime, as many farmers vainly imagine they are able to do, a considerable proportion of it will be found to

be lost by the rain filtering through the soil, and carrying the lime down along with it.

To give some idea of the loſs sustained in this way, we have only to observe what happens where a heap of lime is laid down: if a quantity of rain fall sufficient to saturate the whole, the moisture that runs off will be perfectly white. This colour is given by the finest and lightest particles of the lime being suspended in the water. The same effect certainly takes place upon every limed field; and however judiciously the lime may be employed, it will happen in a certain degree; but when it is ploughed in without being previously harrowed, it will be still worse, as a considerable quantity will be turned to the bottom at once: where it will either be carried into the bowels of the earth, if the soil be open, or concrete into a cake, if the bottom be compact.

It is customary in many places, first to dreſs their fallows with lime, and plough it in; afterwards to manure with dung, and plough it in also. For this practice no sufficient reason is aſsigned: indeed it would be difficult to give one; for if the soil stands in need of lime, the dung is unneceſsary: or if the field has been formerly limed, and the operation of the lime is intended to be principally exerted upon the dung, the design is frustrated by its being previously mixed with the earth. In all cases, therefore, where lime and dung are employed upon the same field, they ought either to be used by way of a compost, or laid on at the same time. In either of these cases the operation of the lime upon the dung will be in a great measure insured. In the former it will be completely so; and perhaps experience will prove this to be one of the best ways of using it. In the latter, though the lime will certainly have a greater effect upon the dung when they are laid on at the same time and ploughed down together, yet it is utterly impoſsible, even in this way, to bring them so completely into contact with each other, as to produce the utmost benefit that might be expected from their union. Few arguments will be neceſsary to prove, that this is only to be done by incorporating them thoroughly, previous to their being laid upon the field.

It has sometimes been given as a reason for not mixing them in the manner we have mentioned, that it could not conveniently be done:

that lime being an article to be had in the market, the farmer can procure and lay it on at any time; but dung being made by slow degrees, by deferring the laying of it on for a month or two, an additional quantity would be obtained, and by that means more land manured. This undoubtedly is a plausible, but by no means a satisfactory reason; for, admitting that more dung is made in the stables during that short time, it does not follow, that the quantity of manure will be increased in proportion. We know the neceſsity of fermentation to common stable-dung or litter, and are perfectly satisfied, that any thing produced in the stables will be very unfit for use in the ordinary way of farm-yard management, in so short a space as a month or six weeks. It is, however, certain, that considerable quantities are every year led out fresh from the stables, and employed in this disgraceful way.

Instead of hurrying it to the field in this raw unfermented state, if farmers would be at the trouble of making three or four dung-hills in place of one, the dung would not only be sooner fermented, but they could, with little labour, and without any loſs, fix upon the dunghill that was best fermented, and use it either by itſelf, or in conjunction with lime, and leave what was last made till it was fit for use. By this management, the whole manure upon a farm would be completely fermented, and no part of it lost.

The former practice is, however, too common; for we very often see, upon a fallow field that has been limed, the occupier straining to cover as much of it as poſsible with manure; and, in the attempt, laying it on in a situation little better than dry straw; so much so indeed, that a stout ploughman and four horses are often unable to take a furrow deep enough to cover it.

When dung and lime are laid upon the same field, if they are not used in the form of a compost, it might be attended with considerable advantage, to lay the lime on so early as to give the land, at least, three ploughings before it is sown; then to put in the wheat, and top-dreſs with the dung early in the spring; or, if barley is sown, to top-dreſs with the dung, and harrow both in together. In a few instances where this practice has been followed, the succeſs has been very great, particularly upon wheat; as the dung is applied at the time when the plants suffer most, and are in greatest danger of being killed. When this method of manuring is adopted, the wheat will, in general, put on a deep verdure in about a week or ten days after the dreſsing is applied; and by the warmth, protection, and nourishment it affords to the plants, they will not only be rendered strong and healthy, but their numbers will be considerably increased by its effects. This is not idle speculation; repeated trials have been made, and the most incredulous may be convinced by a single experiment.

It will no doubt be objected by many, that the strength of the dung thus employed will be lost, from its being dried and exhaled by the sun and atmosphere; that it will be a difficult matter to spread it upon the young crop; and that many of the plants will either be killed, or materially injured, by the carts and horses driving over them.

To this we answer, That in the spring the influence of the sun is small, consequently the evaporation cannot be considerable (during N. E. winds excepted); and what is even then evaporated, consists chiefly of the aqueous parts; that as no body, unleſs it is heated to a certain degree, will part with any of its volatile salts, so none of the salts of the dung can be lost in that way; and that long before the warm weather sets in, the ground will be completely covered with the crop, and the juices of the manure left to soak down slowly and nourish the plants.

The second objection, with regard to spreading the dung equally, is no better founded; for if the dung is properly fermented, (and we have already said that it ought never to be used but when it is so,) it will be rendered so short, that it may be spread with ease; but it is to be observed, that when dung is used as a dreſsing for young crops, it should be spread immediately from the cart, in place of laying it down in heaps. As to any destruction of the plants, that can only happen from the groſsest mismanagement; for if proper attention is paid to laying on the dung when the land is sufficiently dry, they will rather be benefited than hurt by being trod upon; as it is well known that wheat-lands, of every description, if they have been well wrought before the winter, and much hard black frost succeeds, are generally as looſe as a mole-hill in the ſpring, eſpecially ſuch as have been well limed or dunged. This is the greateſt evil to which early wheat is expoſed; for the ſoil, by being rendered looſe and porous, expoſes the roots of the plant to the cold piercing ſpring wind, which too often proves fatal to it. Dreſsing upon the top, at that ſeaſon, with dung or compoſts, promiſes to be a remedy for the evil, which, if properly conducted, will probably be found ſuperior to every other, for affording warmth and nouriſhment to the plants; nor will the benefit be leſs ſenſibly felt if barley is ſown upon the fallow, and the dung harrowed in along with it, particularly if the ſoil be light. The operation of laying on and ſpreading the dung upon the laſt furrow, will give the land a degree of firmneſs and coheſion that will enable it to reſiſt the drought, if dry weather ſhould follow the ſeed-time; and the moment a ſhower falls, the juice of the dung will ſink down, and afford ready nouriſhment for the crop.

It muſt, however, be obſerved, that this mode of dreſsing upon the top of young crops can never be put in practice but when the land is tolerably dry, and the dung well fermented: where this is the case, the returns will be abundant, not only for the present, but succeeding crops. Indeed we have long entertained an opinion, in which we believe many experienced farmers will agree, that a very great proportion of the dung that is laid upon wheat-lands is lost by the winter's rain; for if the dung has been properly prepared, every winter shower that falls will carry away some of the salts from the soil; and, when the spring arrives, a great part of the food of the plants will be found to have perished during the winter; whereas, were the application of the dung deferred till the spring, when the growth of the plant commences, we can readily understand what becomes of it; the wants of the crop would take up all the rich parts after every shower, and their progreſsive increase would constantly demand a new supply; so that every part of the nourishment would be properly applied. On the contrary, as we have already observed, when the manure is laid on in autumn, it is exposed to the continual washings of the winter's rain, and at a time too when it can be of very little service to the plants; for wheat, like every other seed that is sown in autumn, if it vegetates and establishes itself in the earth before winter, does all that can be expected. During the winter it makes no progreſs, consequently needs no aſsistance from the soil; and, as we shall immediately observe, its chance of remaining in the ground is greater where no manure is used, than where it has: the effects of lime and all manures is to open the soil during winter, particularly where much stable-dung has been used; and as the plants make no progreſs during that time, so every thing that opens the soil, and exposes the roots to the cold, must be hurtful; and if to the injury of opening the soil, we add the loſs that is sustained by the salts of the manure being washed away and lost by the rains, we shall readily be convinced, that the application of dung in autumn upon fallows with lime, is very often throwing it away. Indeed, in cases where dung is used by itself upon fallows, the application of this maxim is equally proper, as the best salts of good stable-dung are nearly as perishable, when applied by themselves, as in conjunction with lime. Top-dreſsing in the spring will therefore be proper in this case also, though it will certainly have a greater effect when lime has been ploughed into the fallow: in that case, while the lime is stimulating, and acting upon the principles of the soil, the juices of the dung will be gradually sinking down, and at once correct the hot caustic effects of the lime, and afford nourishment for the crop.

We have dwelt longer upon this point than was intended; but we trust the observations that have been made will not be thought inapplicable to the subject. We come next to speak of the practice of liming for turnips.

2. *Lime for Turnips.*—In this branch of husbandry, the value of lime stands conspicuous; for, by the aſsistance of it, whole districts, formerly useleſs, have been made to produce not only good crops of turnips, but also valuable crops of corn and broad clover. Its greatest value, however, seems to be met with upon light soils for these crops: and this is now so well known, that, in those parts of the country where lime is the principal manure, they seldom attempt to sow either turnips, clover, pease, or beans, except upon lands that have been previously limed; as they know, to a certainty, that these crops will not succeed where no lime has been laid. Examples of this sort are often met with in the uplands; where, if any of the broad-leaved crops are

sown upon a field where a part has been limed, and a part not, even though the whole field has been well dunged, the parts where the lime has been laid will produce a valuable return, while that which has got no lime will hardly repay the expense of seed and labour.

*Method of using Lime for Turnips.*—In different parts of the kingdom, different methods of using lime upon turnip-lands prevail indeed in the same county; scarce any two farmers conduct their operations in the same manner. With some it is the custom to use it only before the last ploughing, and to plough it in without harrowing; they also lay it down in heaps, hot from the kiln, without being slacked. The reason given for this is, that the lime is supposed to have a much greater power upon the principals contained in the earth, when it is in the act of slacking, than it has afterwards; and certainly, if unslacked lime could be broke sufficiently small, and intimately mixed with the soil, it would be found most active in that state; for, from the time a lime-shell is slaked, its activity begins to diminish, and it takes a retrograde course towards the state of lime-stone: the operation of burning lime being nothing more than depriving it of the fixed air and moisture which it contains; and the more completely these two component parts of it are expelled, the better will be the quality of the lime; but so great is the attraction of calcareous earths for fixed air and moisture, that, the moment they are taken out of the fire, they begin to imbibe them, and continue to do so till they are in some degree saturated. But though we are clearly of opinion, that unslacked lime will, if broke small enough, have a greater effect upon the soil than that which is slacked, we condemn the common way of laying it down in heaps before slacking, for the following reasons:

1st, If it is wanted for immediate use, when the weather is dry, it may be a considerable time before a quantity of rain falls sufficient to slack and pulverize it properly: in this case, the ploughing of the field must necessarily be delayed.

2dly, If lime thus laid down in heaps, receive only a certain proportion of moisture, it will be very imperfectly slacked; consequently will not be sufficiently reduced, either for spreading equally, or mixing properly with the earth.

Lastly, If the quantity of moisture is too great, the lime, after being slacked, runs into cakes, which cannot afterwards be broken so small, as to render it useful. Upon the whole, this seems to be a most objectionable way of using lime; for, by delaying the application of it till the last furrow, and ploughing it in without a previous harrowing, it can scarcely be said to be mixed with the soil at all. The consequences of this practice are obvious. When the seeds are put into the ground, in place of having a bed composed of earth, and a due mixture of lime, a great part of them will be laid entirely amongst the lime itself, and the remainder, by falling amongst earth, where there is no mixture of lime, will receive no benefit from it. Owing to this management, a great proportion of the seeds never vegetate, unleſs the season is uncommonly moist; even then, though the plants grow, yet, from the lime being so unequally mixed, they will always sicken in dry warm weather; many of them will die during the summer, and a part of the remainder will be stunted, and of little value.

In short, the same observations that were made with regard to the use of lime upon fallows for wheat, apply with equal propriety to turnips. The sooner it is laid upon the field, and the more ploughings and harrowings it receives before the seed is sown, the better will it be incorporated with the soil, and the more certain and valuable will be its effects; and, what is of singular advantage in the case of turnips, by mixing the lime thoroughly with the soil, its hot caustic qualities will be blunted, and the safety of the seed thereby insured; accordingly, there are fewer instances of turnip crops being hurt by dry weather, where the lime has been well incorporated with the soil, by repeated ploughings and harrowings, than where it has received only one furrow; for it is notorious, that lime in a naked state diſsolves all oils; and when it comes in contact with oily seeds during dry weather, they are rendered incapable of vegetation afterwards.

3. *Lime upon Clover Ley for Oats.*—The practice of laying lime upon clover ley for oats is very common on both sides of the Tweed, and is perhaps the worst way in which it can be used. It is generally laid on in the autumn, and ploughed down in the spring; and the returns in such cases are very inadequate to the expense. Nor can it be other-

wise; for if we attend a single moment to the proceſs, we will be convinced that the lime has no chance of being useful. The oats are generally sown upon clover ley with one furrow, and if the graſs crop has been good, the furrow will be turned over entire; and if lime has been laid upon the surface, it will either be laid flat down to the bottom of the furrow at once, or, if the furrow is set up on edge, it will be left exposed upon the face of it. In either of these cases it is worth inquiring what has become of the lime. The result will satisfy us, that in both instances it is in a great measure lost; for if the furrow is turned flat down, which is often the case, the lime will be so low that it can be of no use to the oat crop; indeed it is impoſsible that it can, as there is the whole thickneſs of the turf between it and the roots of the plant; and this turf is often so compact and tenacious, that it cannot be reduced even by the operation of the harrows. In this situation, if the bottom is open, a great proportion of the lime will be carried down before the next season, and be for ever lost both to the farmer and the proprietor.

If it is left exposed upon the brow or face of the furrow, the consequence is nearly the same as when it is turned down at once; for every shower that falls will wash it down between the furrows. We have observed numberleſs instances of this, where the lime has been as completely washed to the bottom during a heavy shower, as if it had been laid there on purpose.

Farmers complain that lime, when applied in this manner, does not afford a profitable return; or, in their own language, does not pay well. From what we have said, it is hardly to be expected that it can, as the major part of it is turned down to the bottom, where it can have no chance of being incorporated with the soil; consequently can be of no service to the present, and in all probability of very little to succeeding crops.

Upon the whole, we conclude that there is no way in which lime is employed where so much of it is lost, or where the returns are so inadequate to the expense: the practice has scarce a single reason to support it, except the convenience that attends being able to lead out and spread the lime upon ley at any time. Indeed many farmers aſsign this as their only reason for continuing a practice which they know, from experience, to be unprofitable.

4. *Lime as a Top-dreſsing upon young Crops.*—It is customary in some parts to top-dreſs with lime in the spring, both upon graſs and young crops of wheat and other grain. From every observation that we have been able to make, this practice is highly objectionable in most cases; and even where it is ventured upon, the management should be extremely cautious. Upon young crops of grain of every description we pronounce it dangerous, unleſs the lime is made into a compost with other substances, such as dung and earth; in this form the use of it will not only be safe but profitable; and we can readily understand how it should be so: its hot stimulating qualities will be exerted upon the substances with which it is mixed, previous to its being used; and in place of burning and destroying the tender plants, which lime in its naked state always does, it will afford them a valuable nourishment.

5. *Lime as a Top-dreſsing for Meadows.*—With regard to the application of lime as a

top-dreſsing for broad clover, &c. we entertain nearly the same opinion of its effects as for young crops of grain. If it is more useful upon one sort of graſs-ground than another, it will certainly be upon coarse meadows. Upon lands of this description, abounding with rushes and other useleſs plants, it is highly proper; in these situations it is the instrument of death; for it is well known that the coarse herbage in meadows is entirely destroyed by a complete liming. Whether this effect is produced by the lime destroying the plant, or by its altering the nature of the soil so much as to render it incapable of nourishing such herbage in future, may be difficult to determine. Perhaps the last will be found the true cause.

Upon such grounds, therefore, the effects of lime, as a top-dreſsing, will be highly beneficial; and this benefit will be still farther increased, if the meadow is capable of being ploughed; for though lime may be inimical to rushes and other coarse plants, even in a growing state, it will be still more so when their connexion with the soil is destroyed. To summer-plough these meadows, therefore, seems to be the proper plan, and after they have remained for some time in that state, to croſs-plough and expose them to the winter's froſt, then to lay on the lime, and harrow it till the soil is completely reduced, and the lime incorporated therewith. By this management two important points will be gained: by turning down the turf and exposing the roots to the sun and air, the coarse herbage will be in a great measure rotted, and the frequent ploughings and harrowings afterwards given, will incorporate the lime and insure its operation, not only upon the soil itself, but upon the undecayed vegetable substances that remain in it. Thus much of lime upon meadows that can be ploughed. Upon such, however, as cannot be submitted to the plough, the use of lime seems to be an improvement that belongs more properly to the landlord than the tenant; for though lime will ameliorate such meadows considerably, yet the increase in point of value will not be sufficient to afford the farmer a competent return for his labour and outlay of money; and unleſs his lease is very long, he will have the mortification of seeing his stock sunk for the benefit of another. For it should always be remembered, that when a tenant is about to lay out money upon improvements, if he is a man of sense, he will do it in such a way as to afford a reasonable prospect of his being repaid, not only principal and interest in a few years, but also a suitable compensation for his labour and risk.

With a proprietor the case is different; for if his property is benefited so much as to raise its yearly value in proportion to the interest of the sum expended, he can never be a loser; and if the advantage is greater, which in all well-conducted improvements it certainly will be, the overplus will be a reward for his risk and enterprise, and will operate as a stimulus to farther exertions.

The above comprehends nearly the whole of the lime-husbandry of Great Britain, upon which we have delivered our sentiments with freedom and impartiality, and have censured the errors of the present system without hesitation; but, as was formerly observed, our censure has not arisen either from a desire of novelty, or a spirit of detraction, but from conviction built upon a perfect knowledge of the nature of calcareous earths, and their operation upon the principles they meet with in the soil.

We will now attempt to give some directions with respect to the manner of treating lime, previously to its being laid upon the soil; the rotation of crops to be afterwards followed, so as to insure the utmost benefit from its use, without exhausting the land by over exertion, and conclude the article with a few observations.

6. *Method of treating Lime, previously to its being used as a Manure.*—In all cases where lime is employed by itself as manure, its operation must be upon the principles contained in the soil. Taking this for granted, we can at once see the neceſsity and utility of applying it equally to every part of the earth. This can only be done by first dividing the lime into the most minute particles, and breaking the parts of the soil so small, as to make them incorporate readily. To accomplish this purpose, much care and attention will be requisite, both in preparing the lime and labouring the field. If the lime receive a sufficient quantity of moisture, and no more, it will be reduced to a fine powder, capable of being spread equally over the soil: in that state, if properly treated, it will incorporate well, and answer every useful purpose: but

if more moisture is given than is sufficient for slacking it properly, the lime will run into lumps or cakes, as was formerly observed. In this state it will neither spread equally, nor will its effects be good, even though double the usual quantity be laid on. We have already taken notice of the instances in which this caking most readily happens; that is, where the lime is laid down in small heaps, hot from the kiln. Where it is applied in this way, there is scarce a poſsibility of regulating the moisture in such a manner as either to give it the neceſsary quantity, or prevent it from receiving too much.

The only way in which this difficulty can be obviated is, by laying it down near some small rivulet, and throwing water upon it. The trouble of doing this is small, and the advantage arising from it great; for by a little attention, it is not only properly slacked, but is rendered, in an hour's time, fit for laying upon the field; and in every case where it can be done, it ought to be laid on without loſs of time, and well harrowed in; for, independent of its powers being leſsened, by exposure to the air, the chance of its running into lumps is not at an end even after it is spread; for if the quantity laid on is considerable, and the weather moist, it will run into cakes upon the surface as readily as when it remains in heaps. This every good farmer is aware of; and accordingly it is a maxim with them to harrow and plough it in as soon as poſsible.

It sometimes happens, however, that lime is brought home as a matter of convenience, when the other labour upon the farm is slack, consequently at a time when it cannot be used: even in this case it is a matter of importance to have it properly and immediately slacked; some care, however, will be neceſsary, both to preserve it from being weakened by the action of the air, and from running into lumps. Both these purposes may be accomplished by proper attention; for if the lime, after being slacked, is thrown up regularly in the form of a ridge, with a sufficient slope to carry off the water, and covered to the depth of three or four inches with earth, and the top of the ridge secured with thatch, it may be kept in this way for three or four months, and taken out of the heap at the end of that time in a state nearly as active as when it came from the kiln.

7. *Rotation of Crops after Lime.*—Much of the benefit attending the use of lime depends upon the rotation of crops that is pursued after its application. In the Preliminary Observations it was noticed, that upon some lands where lime had produced valuable crops for a few years, total barrenneſs was induced. Many instances of this are to be met with; and in all of these cases the mischief has been distinctly traced to bad management. Upon light soils, which are soonest exhausted, if several white crops are taken in ſucceſsion after liming, the land will be rendered uſeleſs; accordingly the evil we have mentioned has uniformly happened upon such soil, and always from the same cause. The method of cropping, which experience has now proved to be the best after lime, is to take a white and a green crop alternately: with some it is the practice to sow wheat after the turnips, which must be a precarious crop, unleſs when sown in autumn, as is done in Suſsex. Many intelligent farmers, however, in other parts of the kingdom, particularly to the north, never attempt wheat after their turnips. In place of it, they generally take a crop of barley or oats, which seldom fails to be good; and, along with these, they sow broad clover, which is for the

most part ploughed down the second year, and a crop of oats taken off the ley. This last is generally the best crop of the whole; the oat stubble is then ploughed, as a preparation for another crop of turnips or beans, with dung. By this management a white and green crop succeed in alternate rotation, and the land is preserved in a state of constant fertility.

Poor lands of this sort are oftener sown with turnips, broad-cast, after the summer fallow, and without dung. When sown in this way, the turnips seldom attain a great size; but what is wanting in bulk, is, in some degree, made up in numbers. A crop of this sort is generally valued at from twenty to forty shillings an acre, and is employed to advantage in feeding the young sheep, known by the name of Hogs, which generally thrive and get into good condition upon them. Turnips to these sheep are reckoned a preservation against the disease termed the Graſs-ill; which, in some seasons, kills great numbers of them.

The last circumstance deserves particular attention; for if, upon inquiry, it is found that turnips prevent, or even palliate this distemper, a sufficiency may be raised upon every dry farm throughout the kingdom, by ploughing the wheat or oat stubbles immediately after the grain is cut, and sowing the turnips broad-cast: in this way they could not poſsibly arrive at any size; but the tops would afford a sufficient quantity of excellent herbage, which, perhaps, is the most valuable part of the remedy. If the crop be eaten upon the field, two material benefits would be derived from the practice: 1st, The sheep are fed, and the disease prevented. 2d, The land is greatly benefited; so much so indeed, that it is generally thought the produce of the succeeding oat crop will be considerably increased.

8. *Rotation upon Clays with Lime.*—The foregoing observations apply strictly to suit turnip soils. Upon clays, the management will require to be different; on this species of soil, turnips ought never to be attempted; not because they will not grow, for in favourable seasons valuable crops of them may be sometimes raised upon very strong land; but they are liable to so many accidents from wet weather, both before sowing and during their growth; and the inconveniences and loſs that

attend taking them off the land, even after they have arrived at maturity, are so great, that no prudent farmer would attempt to raise them, as the land is often more injured by carrying them off, than the worth of the most valuable crop.

Upon such lands a summer fallow seems indispensable; in that caſe, the lime should be laid on in July or August, and completely harrowed in before ploughing: two or three furrows is the least that will be required to incorporate it thoroughly with the earth, and a suitable harrowing with each. The approved rotation upon strong clays with lime is,

1st, Wheat.
2d, Beans.
3d, Barley.
4th, Clover.
5th, Oats upon the Clover Ley.

9. *Rotation upon Heath-Ground with Lime.*—Upon lands where heath grows vigorously, no other plant can be succeſsfully introduced without the aſsistance of lime: previous to its application, however, the heath should be burnt, and the land fallowed. The burning of the heath will not only prevent the operation of the plough from being interrupted,

but will also suffer the sward to be more completely turned down, and the furrows to clap closer to each other; and the length of time that is allowed, together with the winter's frost, will both secure the rotting of the turf, and aſsist in pulverizing the soil. These two points gained, the lime may then be applied and well harrowed in; and if the season is not too far advanced, a crop of turnips may be sown, broad-cast, and eaten off with sheep; this will be a good preparation for a crop of oats, which, in general, will be an abundant one. By this management we have known ten bolls of oats raised upon an acre of land, which, before the liming, was not worth half a crown yearly, and that too in very elevated situations. Graſs-seeds are generally sown with the oats, and the land either continued in pasture, or put under the rotation mentioned for poor turnip soils. To point out the proper rotation for all the different soils with lime, would be a tedious, and indeed an unavailing task, as the gradations of soil are like the shades of colour, impoſsible to be defined; we trust, however, that the above will be thought sufficient. Upon soils which are distinctly marked, such as clay, loam, moor, &c. the observations which have been made, will, we hope, be found just. Upon all the intermediate soils, the judgment of the farmer muſt be employed, and according as he is able to claſs them with clays, loams, gravel, &c. they will be put under the rotation mentioned for any of these.

Having dwelt at considerable length upon the nature of lime, and the various methods of using it, we will now conclude the article with some general observations respecting its effects upon the different seeds, plants, &c.

It has been observed, that lime, both alone and in conjunction with alkaline salt, has the power of uniting with all oily and fat substances. Now, as all the seeds and plants with which we are acquainted, contain more or leſs oil, lime will have a proportionable effect upon them. Lime also probably acts by killing insects, as well as destroying vegetables, which thus furnish nourishment to the plant to be produced. It may be considered likewise as a stimulus to the plants, and as operating mechanically, by dividing the soil and absorbing water.

The seeds of most annual weeds contain oil in considerable quantity, particularly the different kinds of mustard. These are the greatest enemies that farmers have to contend with, particularly upon light free soils, where, if a shower accidently falls immediately after the field is sown, a thick crop of annuals immediately comes up, and very effectually ruins the grain.

The cause of this failure has generally been ascribed to the annuals choaking the corn. No doubt this is partly the reason: but the real cause seems to be the immense quantity of oil and useful principles that are extracted from the soil by the annuals, and which exceed in an uncommon proportion the nourishment that is required to produce the most luxuriant crop of grain. These *annuals* indeed occupy the ground, and get the food which were destined for the crop intended to be obtained.

This accounts in a very satisfactory manner for the greater degree of poverty that is observed in land after a bad than a good crop: every farmer of experience is sensible of this. Indeed there is no crop with which we are acquainted that exhausts the soil so much as these annuals, except rape, when the seed is ripened; or hemp and flax; and their exhausting effects are owing to the same cause.

Upon soils which abound with these seeds, lime will be found an effectual remedy, if judiciously applied: indeed, in whatever form it is used, it will destroy them in a certain degree: but if it is thoroughly incorporated with the earth, and the field laid down to graſs, the effect will be more certain, as the lime will not be disturbed in its operation upon those seeds, which it is liable to be in cases where the land is kept in tillage. Where this plan is followed, and the ground allowed to remain in graſs for two or three years, at the end of that time the annuals will be found destroyed, with this additional advantage, that they will be converted into rich nourishment for the grain that is afterwards sown. This last is no inconsiderable object; for whoever considers the immense numbers of annual seeds which are in all light soils, will be convinced that a very considerable quantity of nourishment, and that too of the best quality, will be acquired by their destruction. To destroy weeds in the first instance, is certainly an important point gained; but to convert them into manure for the grain, is turning a nuisance into a benefit. Nor is this the only advantage that is gained; snails and other vermin, which are particularly baneful to green crops, are also destroyed.

These circumstances, while they hold out to practical farmers a prospect not only of destroying weeds, but also of enriching the soil, enable them, at the same time, to take precautions against their useful crops being injured by the same cause. All the different grains, and the seed of that useful plant the turnip, contain oil in considerable quantity; and if any of them are sown upon land where lime is in an active state, if the ground is dry, and no rain falls for some time after they are sown, the seeds will be very much injured, a considerable part will be entirely lost, and the remainder, though they vegetate, will be sickly and imperfect.

In a field that has suffered by drought in this way, if the seeds which have not vegetated are picked up and carefully examined, they will be found light and shrivelled: an appearance which has generally been ascribed to the action of the heat. This, however, is by no means the case; for all the different sorts of grain and turnip-seed may be exposed to a much greater degree of heat than they are likely to meet with in the earth, without any risk of their being hurt. We need hardly add, that it should be a principal object with every farmer to conduct his operations in such a way as to retain a sufficient quantity of moisture in the land to vegetate his plants immediately after they are sown: that point once gained, they are in no great danger of being hurt by dry weather thereafter.

10. *Neceſsity of giving a thorough Liming at once.*—Considering lime as a substance operating upon the living substances contained in the soil, as well as mechanically upon the soil itself, we can readily perceive the utility, and even neceſsity, of applying a sufficient quantity of it at once, in order to produce these effects; for if the quantity employed is small, and the soil deep, its effects will scarce be visible. Hence we can distinctly perceive how a small quantity of lime, laid upon particular soils, will often be lost; whereas a larger dose would have been highly beneficial. This circumstance has led many farmers to imagine that lime would not answer upon

their lands, and of course to abandon the use of it; whereas a little judgment would have convinced them, that the miscarriage was owing not so much to the lime being improper, as the quantity being too small.

This leads us to notice the practice in many of the English counties, where the farmers are obliged, by their leases, to lay on a certain quantity of lime every three or four years. We have marked the accounts of these counties with singular attention, and have thought seriously of the reasons that could induce proprietors to propose, or farmers to agree, to such absurd stipulations. In districts where the generality of the farmers are tenants at will, it is reasonable to expect, that landlords will guard their property by restraining clauses. This certainly is right; and if covenants are more neceſsary in one situation than another, it is in the case of a yearly lease. But to oblige a farmer to lay a given quantity of lime upon lands of every description, every two or three years, carries absurdity on the face of it; for it is well known, that every difference of soil requires a different quantity of lime. If the quantity, therefore, which the tenant is obliged to lay on is sufficient for his heavy lands, it will be more than an overdose for his light soils. This is the first inconvenience that attends a covenant of this kind. The second is more serious; for if the first liming is sufficient, a repetition of it at so short a distance of time, would be highly injurious. It is argued in defence of the custom, that the quantity is in general so small, that it has no very great effect upon the soil, and that it will bear to be repeated frequently before a sufficient dose is given. This argument, however, is nugatory; for we have already shown, that a small quantity of lime can never produce any beneficial effect, except upon the very lightest soils; and as to its remaining in the ground till a sufficient quantity is thrown in by repeated doses, at the distance of two or three years, nothing but the grofsest ignorance and folly could make any person expect it; for even where a complete liming is bestowed upon land, a very great proportion of it is found at the bottom of the furrow after the second year; and we have no reason to expect, that it will be otherwise when a small dose is applied. But, independent of this circumstance, lime that has lain three years in the ground, will have imbibed so much moisture and fixed air, that it will be nearly in the state of unburnt lime-stone; consequently will poſseſs little or no activity. In short, reason and common sense enter the strongest protest against the custom, which is founded in ignorance, and ruinous both to the farmer and the soil. Indeed there is no covenant between landlord and tenant so effectually calculated to defeat its own purpose; for while the landlord is flattering himself with the hope of enriching his property, and the tenant is bestowing labour and money for that end, the plan is rendered abortive, and the land reduced to a *caput mortuum*. For though lime, under proper management, is of advantage to most soils, yet the quantity must be exactly regulated by the nature of the particular soil.

We are of opinion, therefore, that a complete dose of lime should always be given at once, and that this liming should be regulated by the deepneſs and other known qualities of the soil; for it cannot be too often repeated, that what is a sufficient dose for one soil, will hardly be felt upon another; but when this quantity has once been laid on, it ought never afterwards to be applied by itself.

But though we thus interdict the repetition of lime in a simple state, at least for many years, we entertain a high opinion of its value in the form of a compost. In its naked state, it produces the effects above mentioned; and these points being gained, a farther application may be hurtful; but when made into a compost, it feeds, in place of stimulating the earth, and its action is exerted in diſsolving, and reducing to a state of complete putrefaction the substances with which it is mixed. In this way lime may be used for ever, even upon the same soil, provided care is taken to mix it well with good dung and new earth; and if the landlords, in place of the present injudicious covenants of liming every two or three years, were to propose to their tenants to lay on a compost of lime, dung, and earth, either for their turnips or wheat, both parties would be gainers by the change.

The foregoing circumstances, while they explain the danger of overliming land, at the same time point out a remedy for the injury. As was formerly said, the quantity of lime employed ought always to be regulated by the quality of the soil; in all cases, therefore, where the lime has been in too great proportion, a considerable quantity of it will remain in an active state, after destroying the animal and vegetable substances; while this is the case, it is in vain to expect that good crops can be raised; the application of mucilaginous and oily manures can alone repair the injury; and, if they are used in sufficient quantity, they will answer that end very effectually. Stable-dung, sea-weed, oil-cake, garbage, &c. &c. are the substances that abound most with mucilage and oil; and, by the use of them, every bad consequence attending the excessive use of lime may be obviated. It is to be noticed, however, that a succeſsion of white crops is to be avoided, after the application of these rich manures, and the land laid down to graſs. By this management for a few years, its vigour will be restored.

We cannot conclude this article, without recurring to the manner of mixing lime with the soil. We have said, that, in order to be useful, it should be well incorporated with the earth, and that frequent ploughings and harrowings are the only means to be depended on for that purpose. The first thing to be noticed, is the spreading: this operation should be performed with the utmost care, and, if poſsible, always done in calm weather; for, if the wind is high, a part of the ground will be whitened by a thin coat blown upon it, which will deceive the person who spreads it; whose eyes being annoyed by the lime, will not enable him to distinguish between the spots that are thus whitened by the dust, and those that have got a proper coat: even, with every poſsible care, the spreading will be unequal; so much so, indeed, that a common harrowing will not mix it properly. To obviate this in some degree, bush-harrowing should be practised in the following manner: A quantity of furze, or thorns, should be put under a pair of common harrows, or even a brake, the heavier the better, and the land completely harrowed with them. The common harrows should then be used, without any furze; and, in this operation, it is hardly poſsible to do too much, for the oftener the harrow goes over the land, the more intimately will the lime be mixed with the soil. The next thing to be attended to is the subsequent ploughings: and here it may be proper to observe, that they should never be very deep, particularly if the quantity of lime has been moderate; for if the soil is deep, and the quantity of lime small, very deep ploughing would not only bury a part of the lime, and place it beyond the reach of being useful, but would mix it with too great a quantity of earth. To prevent this, when lime is ploughed in, the first furrow should not be more than two or three inches deep, and the subsequent ploughings should never exceed four inches; by this means the lime, as well as the soil it has acted upon, will be kept uppermost, and rendered useful; whereas, by ploughing deeper, and mixing it with more earth, the benefit would not only be leſs, but also more uncertain.

One mode of using lime may here be mentioned; which is the most curious circumstance in British husbandry, connected with this species of manure, namely, the application of 500, or even of 600 bushels per acre, on peat soils or moors; and thus, without any additional trouble whatever, raising them from one shilling to twenty-five shillings per acre, which has been done in the Peak of Derby. It is evident, however, that this can only be effected where lime-stone is in great abundance, and where fuel for burning it is cheap.

# ESSAY XXII.

## *On Peat-Moſs, as a Manure.*

Moss being a vegetable production, it is reasonable to suppose that it may be converted into a manure; for this purpose many attempts have been made, but all of them have hitherto proved abortive, from the difficulty of subjecting it to the proceſs of fermentation; by which means a substance containing nearly one half of its weight of the finest vegetable mould, together with a great proportion of oil and other principles, has not only remained uſeleſs, but has been considered as a nuisance.

A knowledge of the properties of animal and vegetable substances, informs us that they are more or leſs liable to putrefaction, according as they contain more or leſs of an acid, or alkali, in their composition. If the acid prevails, putrefaction takes place slowly, and with difficulty; but if the alkali prevails, putrefaction takes place very suddenly. The analysis of peat-moſs demonstrates that it contains an acid, in most cases nearly in the proportion of one-fourth of its weight. Its other constituent parts are *oil, alkaline salts,* and *vegetable earth ;* these three last principles are known to be highly useful in vegetation, but when combined with an acid, their valuable qualities are not only locked up, but the whole maſs is prevented from fermenting, by which proceſs alone it can be rendered useful.

In considering this matter attentively, three questions arise, the first is:—can the acid in moſs be corrected? the second; will it then be susceptible of fermentation? the third, and most important of the three; will it then be a good manure? and can it be prepared at a reasonable expense? All of these questions we are able to answer in the affirmative:—the acid can be corrected at a trifling expense; when that is accomplished, moſs being a vegetable substance will ferment in nearly the same circumstances as other vegetables do, and the produce will be equally valuable as a manure. All this can be accomplished with small trouble, and at an expense trifling indeed when compared to the advantage resulting from it.

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Every one acquainted with *chemical affinities*, knows that acids unite with alkaline salts and absorbent earths in preference to every other body; nay, so strong is their attraction for these, that when they are found joined to any other substance, they immediately quit that and unite with them; for instance, if a compound consisting of an acid and a metal, has an absorbent earth, or an alkali, presented to it, the acid separates itself from the metal and joins the alkali or absorbent earth. Alkaline salts and calcareous, or absorbent earths, are therefore the proper correctors of moſs, and if applied with judgment, will answer that purpose very effectually. Having advanced this opinion, we proceed to describe the different ways of preparing moſs for a manure.

1st, Lay moſs that has been well dried *, to the thickneſs of three or four feet, in the bottom of a dunghill, let the whole of the dung from the stables be laid above it, and suffered to ferment there. During the proceſs, the natural moisture of the dung will sink down, and not only correct the acidity, but saturate it completely with the valuable properties of the dung. In this state it is ready for fermentation. This method of preparing moſs, on account of the care with which it is performed, will generally be preferred, and perhaps there is no way in which it can be done with equal advantage, as the acidity is not only destroyed, and the moſs filled like a sponge with rich materials, but the dung will aſsist in subjecting it to fermentation. While it remains at the bottom of the heap, however, it will not ferment, the weight of the dung and the moisture it contains, being insuperable obstacles to the proceſs.

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* Unleſs moſs is properly dried and broke small, previous to its being mixed with other substances, every attempt to correct its acidity, or render it useful, will be abortive.

In this state of things the dunghill should be turned over, and the dung and moſs carefully mixed during the operation; if this is properly done, and the whole thrown up lightly together, a gentle fermentation will soon come on, and of this ferment the moſs will partake. After remaining in this state for a few weeks, it should again be turned, and a quantity of lime added, in the proportion of one load of lime to five loads of moſs; the whole should be well broken and accurately mixed; the addition of the lime will accelerate the putrefaction of the moſs, diſſolve the oil contained in it, and give a due degree of activity to the whole.

2d, When it is preferred to lay the moſs by itſelf, the whole urine of the cattle, moisture of the dunghill, soap-suds, and offal of the house, should be poured upon it; and if this is carefully done, the effect will be nearly the same as when the moſs is laid in the bottom of the dunghill; in this case the acidity will be completely destroyed, and if it is afterwards mixed with stable-dung and lime, it will be equally valuable.

3d. The last way of rendering moſs useful, is by mixing it with pot-ash, kelp, lime, or chalk.

In the distant parts of the country, where moſs abounds, and other manures are obtained with difficulty, this is perhaps the most important way of any. When pot-ash is made use of, the quantity required to correct the acidity of moſs, and render it susceptible of putrefaction is so small, that it can be easy obtained; 80 or 100 pounds weight, if properly used, will be quite enough for saturating a quantity of moſs sufficient for an acre; indeed, if the moſs is completely dried, much leſs will suffice.

The way of insuring the operation of the *pot-ash* upon the moſs, is to diſsolve it in boiling water; for that purpose the moſs, after being dried, should be well broke, and a space, occupying a long square, covered with it to the depth of a foot; a fire should be kindled near it, with a large copper that will contain a considerable quantity of water, for every gallon of which half a pound of pot-ash should be put into the copper, and carefully stirred till the water boil; it should then be taken out and sprinkled with a watering-pan over the moſs; the copper again filled, and the same quantity of pot-ash added, till the whole stratum of moſs is properly saturated with the ley. When this is sufficiently done, a fresh stratum should be laid on, and treated in the same manner, and so on, increasing the heap to any size.

When a sufficient quantity of moſs has been saturated in this manner, it should be left to itself for some weeks, and then turned; while the turning is going on, a quantity of the freshest and most active lime should be added, taking care to work it well into the moſs with the spade; after remaining in that state for some time longer, it should be again turned, and every part of it broke as small as poſsible. A gentle fermentation will succeed this last operation, and in a month or six weeks, the whole will be ready for use.

The principal points to be attended to in preparing all these composts, are—

1. To dry the moſs sufficiently.
2. To break it as small as poſsible.
3. To incorporate the other substances well with it.
4. To allow it to rest a sufficient time after each turning.

1. *Method of using Moſs as a Manure.*—Upon thin gravels, or sharp active soils, such as chalk or limestone, the effects of moſs prepared in any of these ways would be found highly beneficial, not only as a manure, but also for thickening the soil. It will likewise

be of service for thin clays; upon deep clays its effects will not be so sensibly felt, as these soils contain in themselves a sufficient quantity of the principles with which moſs abounds; namely, oil and vegetable earth.

If the moſs has been thoroughly broke, it will be found an excellent top-dreſsing either for young crops, or for poor pastures; upon cold clays, or light sandy soils, when used for wheat, it should be laid on in the spring upon the young plants. For barley, or other crops that are not to stand the winter, it may be harrowed in with the seed.

It is worthy of remark, that, in the hilly parts of a country where moſs abounds, a great proportion of the arable land, (particularly that part of it which inclines much to the south,) is either a light gravel, or a thin clay. It is upon these thin lands that the baneful effects of injudicious liming have been most sensibly felt; having little subſtance for the lime to act upon, they are soon exhausted of their oils, and are then in worse than a state of nature. To remedy this evil by the application of rich oily manures, is impoſsible in those parts, as little manure of that sort is made, and being remote from great towns, none can be bought.

In such situations, the moſs presents itself as a remedy; and, if properly used, it will in general be found to answer the purpose: indeed, the application of moſs to such grounds, is only restoring to them a part of what they formerly poſseſsed; for a very considerable proportion of the earthy parts of moſs consists of the fine particles of the soil that have been washed down from the hills and elevated grounds by the rains, and deposited in the hollows.

Every farmer in the uplands should have three heaps of moſs in a state of preparation, viz. one in the bottom of his dunghill, another upon which the urine of the stables, together with the soap-suds, and offal of the house is poured, and a third to mix with pot-ash and lime, &c. &c.; by these methods, and at a very inconsiderable expense, five or six times the quantity of manure that is usually made might be procured, the produce of which in grain, and the increased quantity that would every year arise from the additional quantity of straw, would bring the cultivation of these parts to as high a degree of perfection as they are susceptible of.

Some farmers may be inclined to think, that such minute attention to matters of this sort is unneceſsary, and that the advantage arising therefrom will not compensate for the labour that is bestowed upon them; but we hope the intelligent part of that claſs of men will readily see and be convinced of the utility of it. In the single article of the offal of a farm-house, whoever considers the immense quantity of *urine, soap-suds, dirty water,* and other excremental matters that are daily thrown away careleſsly about every farm-house in the kingdom, all of them impregnated either with oil or alkaline salts, will at once perceive the value of them, when collected for a whole year. To do this effectually, no way seems so proper as pouring them upon moſs, earth, or such substances as will absorb and retain them.

This account of the properties of moſs is not founded in conjecture or idle speculation, but proceeds upon a correct knowledge of its constituent parts, obtained by a careful analysis, and from repeated trials of its effects, both by mixing it with dung, urine, pot-ash, and lime, all of which have been completely ſucceſsful.

## ESSAY XXIII.

### *On Sheep Folding.*

The practice of folding sheep as a manure, or rather as a top-dreſsing, is common in many parts of England, and is productive of conſiderable advantage. They are folded both upon arable and pasture lands; upon the arable lands it is sometimes done before the last furrow, at other times after the grain is sown. This last is found, from experience, to be the best method of folding, as the urine and dung of the animal remain upon the surface, and soak down gradually; whereas, when the field is folded before the last ploughing, a considerable part of the manure is turned down *and lost*. The spring and summer seems to be the time when this practice is most beneficial;

at that time the food of the animal is rich and juicy, but during the winter, unleſs the sheep are fed upon turnips or hay, their dung is of small value.

It is obvious that folding, after the grain is sown, can never be practised but upon dry soils, and during dry weather.

This way of manuring seems peculiarly adapted to farms where there is a considerable extent of hill, or common pasture, or graſs lands, that never come under the plough. In these cases, by bringing the sheep in the evening to the fold, a considerable quantity of manure will be saved, that would otherwise be lost. If the pasture upon which the sheep feed through the day is good, they may be folded, without any detriment to the animal, (if not intended to be fattened,) for a great part of the year; but where the pasture is scanty, this cannot be done, as they will not be able to pick up a sufficiency of food through the day to enable them to bear the fatigue of travelling to and from the fold, and fasting all night.

When they are fed in the fold, the case is different; but feeding in the fold will not admit of being practised as a top-dreſsing after the seed is put in; it seems best calculated as a preparation for wheat or barley upon fallows; in either of these cases, they may be fed in the fold with propriety, as the offal of their food will be ploughed in with the last furrow, and the land properly opened for the reception of the seed: even this requires to be done upon dry light soils; upon these a gentle shower will not be felt, nor will there be any danger of the land being battered with the feet of the sheep; whereas, upon clays or deep loams, the soil will sustain more injury by the treading of the sheep in wet weather, than all the benefit communicated by their manure.

The custom of putting a great number of sheep into a small fold is very common, allowing them little more than a square yard each, and confining together sheep of every description, young and old, strong and weak; both practices are bad. In the first, if sheep are fed in the fold, the space allotted to each will be so small, that they will be crowded, and a considerable quantity of their food trodden down and destroyed; the breaths of so many confined together, within such narrow limits, will keep them too warm, and when they are disposed to lay themselves down, there will not be sufficient room for that purpose.

To avoid these inconveniences, a space containing room enough to afford three or four square yards to every sheep, would answer the purpose much better, and though this large area would not receive so much advantage from one night's folding, yet by allowing the sheep to remain upon it for two or three nights, it would be sufficiently manured, with this additional benefit, that no part of the fodder would be destroyed by trampling upon, and the animals would have a dry bed and plenty of room.

The second defect in the present way of folding is equally bad, if not worse, that is the custom of folding sheep of every description together. When a great number, either of sheep or other animals, are put together to feed, unleſs they have an over quantity of food given them, (which every good farmer would wish to avoid) there will always be a struggle who shall get most of it; in a contest of that kind, it is evident that the strongest will succeed, and by depriving the weaker ones of their food, their weakneſs will be increased, and a risk incurred of losing them altogether; whereas, by picking the flock, and folding the strong and weak sheep separately, both would be benefited thereby; the strong ones would still have a sufficiency of food, and the weaker sort would be allowed to feed, and lie at their ease; in this situation they would gain strength, and improve in value, in the former they would be daily growing worse.

In short, wherever folding is practised, it should be a principal object with the farmer to aſsort his flock, and as near as poſsible to claſs those of the same age and strength together, and whatever preference is given, either in the quantity or quality of the food, it should fall to the share of the young and weak.

The practice is certainly entitled to the notice of farmers in every part of the kingdom; but in that as in every other branch of Agriculture, much must be left to the judgment and attention of the farmer himself, it being impoſsible to lay down rules that will apply t all the different circumstances of soil, situation &c. It certainly is best adapted for dry land

and farms containing much pasture that is never ploughed; upon these, as we have already observed, much manure may be collected that would otherwise be lost; but upon farms that are entirely arable, and where graſs makes a part of the rotation, to bring the flock from the pasture and fold them upon another field, is depriving the graſs field of a great part of the benefit that might be expected from its being in pasture, and is enriching one part of the farm at the expense of another. The only instance in which it is warrantable upon an arable farm, is in cases where turnips are raised either upon clay or heavy loam; in either of these cases they may be eaten with advantage upon graſs or stubble fields, as no farmer of common sense would think of eating them where they grow; but as we have already observed, the propriety of this must be left to the judgment of the farmer; much advantage may certainly be derived from it in some situations, and great loſs sustained in others.

# ESSAY XXIV.

## *On a new method of preparing Compost to be used as a Top-Dreſsing.*

I AM happy that it is in my power to offer some thoughts on a new method of preparing dung for manure; a method, in my opinion, far more useful than any hitherto employed by husbandmen; a few accidental observations first attracted my attention, and directed my study to this important article; and I shall rejoice if my remarks may be thought to have any ways contributed to the improvement of an art which is the basis of all others, and the first source of the real wealth of nations, especially in a country where agriculture is perhaps the sole, at least the chief, support of national industry.

Our common manures are ordinarily nothing but the useleſs remains of various substances. I know, however, that many substances of the three kingdoms of nature, afford excellent manures for artificial vegetation; but these substances either are to be found in a small quantity, or nature has granted them exclusively to some countries. I know also that some rural economists have taught a variety of other methods, that widely differ from those in general use with husbandmen, but none have as yet reached the last point of perfection in this important buſineſs: this I have no ill-founded hopes of having accomplished, if it be true, that to follow nature, and to inquire into her operations with unprejudiced sincerity, is the shortest and surest way of arriving at the most difficult and useful discoveries, for with such a disposition I undertook and continued my researches. I began, therefore, to examine what is the chief principle or cause, at least apparent, which renders some substances so wonderfully productive of vegetation; for this purpose, I instituted a proceſs exactly similar to the work of nature, which seems to be but a simple lotion of substances with rain water when spread on the field. Pigeon-dung was the first manure I subjected to this simple analysis. We know that pigeon-dung is considered as a substance of the greatest activity in fertilizing the earth, and chiefly when old, and a long time kept from rain, from the immediate action of the sun, and from exceſsive dryneſs. I diluted it in water, and when the earthy part had subsided to the bottom of the veſsel, I poured off the clean water; afterwards I caused the water to be evaporated by a slow fire, to such a degree as I thought sufficient to give way to the crystalization of salts contained in it, and then I withdrew it from the fire, and left it to cool for that purpose, according to the common practice. I obtained such a quantity of salt, as similar experiments on four times the quantity of ordinary manure could not have produced. But here an observation is made, and I am asked, whether by these experiments I intend to demonstrate what needs no demonstration, and what is too notorious to admit of a doubt, that salt fertilizes the soil, and therefore increases vegetation. That this opinion is universally received, I am not inclined to contest, though respectable names have proposed it, and others, as respectable, have been cited to discredit it.

I find it openly denied by the Abbe Bertholin, in his treatise on the electricity of vegetables*; 'it is demonstrated,' says he, 'by experiments, that salts are by no means useful to vegetation;' and in order to support his aſsertion, he has recourse to the experiments of Meſsrs. Craft, Alston, and Bonnet, whose authority is not generally overlooked; but I acknowledge that all this only proves that the wisest men are often easily intoxicated by a paſsionate fondneſs for a favourite system. It was the eager wish of the Abbe Bertholin, that electricity alone should be esteemed the cause of vegetation; it was also the opinion of one of our learned Italian economists, that it should be attributed entirely to inflammable air: in vain would it be denied that electricity and various aeriform substances, whatever be their nature, have some influence on the increase of vegetable life; but such is the subtility of these aerial fluids, that they escape even from the very phials in which they are compreſsed to gratify the eye of physical curiosity: it will, therefore, be more prudent to tie down our researches to such objects only as are subject to our control: good manure may be scattered by every husbandman over his own fields. As for electricity, and other substances dispersed through the wide expanse of the atmosphere; they are as yet beyond the reach of art, and must be abandoned to nature. But how shall we reconcile these different opinions as to the utility or danger of salts in promoting vegetation; I beg leave to advance a few words which this digreſsion seems to call for, and which will better unfold my thoughts on this subject.

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* Lion, 1783. p. 133.

Salts (it has been said) are the chief means to increase vegetation; but this, I think, depends on peculiar circumstances; salts must be mixed in a certain proportion, or perhaps intimately united to the earthly principle in which they are generated, in order that they may be advantageous to vegetation; and on the contrary, when such proportions are not preserved, or when salts are disengaged and uncombined, they are apt to be injurious to vegetable life, as Alston, Bonnet, and many other authors, have already observed *.

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* I do not know that experiments have been accurately made on this subject: or, in sprinkling over a small space of wheat-land, or of meadow-ground with water, in which salts of different kinds were diſsolved, attention has been paid to the just and various proportion of salts and water; to the space and nature of the soil; to the climate and seasons, and to the nature of the vegetables. Perhaps a small quantity of a certain salt may be sufficient to increase the natural vegetation

It is not salt, strictly so called, that enters into vegetables, and forms of itself alone a constituent part of them: salt is but a medium by which the element of earth is better attenuated and diſsolved, and thereby more

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of certain plants, while a greater one may destroy them. Inattention to these particulars might have rendered experiments deceitful, and induced the great authorities above-mentioned into a precipitate judgment against the use and advantage of salts. The analogy between animal and vegetable nutrition seems somewhat to strengthen my opinion; saline juices are bestowed by nature for the purpose of helping the elaboration or concoction of those matters, which afford the great store of general nutrition: spittle, gastric juices, gall concreatic fluid, all partake, some more or leſs, of a saline nature or of a very analogous one. We make use also of salt in our common aliments, which certainly helps digestion, whilst a greater quantity, or the abuse of it, would prove contrary to it, and give rise to several diseases, as we may observe in those who are obliged to feed upon salt provisions. The same advantage or inconvenience may happen, it seems, to vegetables; and this is the reason why the most scrupulous attention ought to be recommended in performing such experiments, as they are always apt to miscarry, when every circumstance is not minutely considered; a proportion must certainly exist which renders salts useful to vegetation; otherwise no reason can be aſsigned for the wonderful vegetative qualified to be taken up in greater quantities by the minuter roots of vegetables. Were this not the case, what reason can be assigned why gypsum, for instance, spread in the smallest quantity over a field of trefoil, contributes so wonderfully to the increase of its vegetation. We, no doubt, admit the ancient well-established adage, *ex nihilo nihil fit*, and consequently we do not contend that a few pounds of gypsum can be transformed into an infinitely greater quantity of trefoil: for what is gypsum, but a kind of neutral salt, generated by the combination of vitriolic acid with calcareous earth [*]. Of a like nature lime, in some respects, may be claſsed among the same fertilizing substances. The same remark holds good with respect to the rubbish of ancient buildings, which also proves very

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quality of those manures which most abound with them.

I could wish those hints were capable of exciting the inquisitive faculties of some recluse philosopher, who has the good sense to find pleasure in the useful pursuits of Agriculture: a signal advantage to rural economy might certainly be expected from the exact observations of such a man.

[*] Macquer Dict. de Chimie Art. Plâtre.

friendly to vegetation, and contains a great deal of nitrous salt. In a word, were we to take a review of the various substances employed for fertilizing the earth, we should find new reasons to support our aſsertions. Even oils, which by several rural economists are deemed neceſsary to vegetation, must previously be reduced to a state of neutral salt. If indeed oils exist in our ordinary manures, they must, by their remaining long exposed to the action of the air, grow rancid, be condensed, and their acid principle, then superabundant, being combined with their earthy part, must change them into a true neutral salt.

It would be otherwise impoſsible to conceive how oils are not rather injurious than beneficial to vegetation; whatsoever be the contrary sentiments of those who imagine they see them operate in the fields with as much facility as theories are formed in the closet. It is very easy to conceive how water, air, and the element of fire, that is, the more fine and penetrating elements, may enter in an undetermined quantity into the natural constitution of vegetables; but as to earth, we may say, that it requires some particular medium, in order to qualify it to enter in greater quantity into the substance of vegetables, and thus increase its ordinary virtue in promoting vegetation: what then can be this medium, but a substance, which by its easy solubility in water, the principle vehicle of nutrition of vegetables, may facilitate also the solution of another which is naturally soluble in it, but in a very small proportion: this, I believe, is a point that will not be contested by any one who is even superficially acquainted with the chemical affinities.

But perhaps some may be tempted to say, that the epidemical itch of theory has tainted me, as well as all the throng of rural economists, whose labours are confined to their closets, and that from the beginning such theoretical nothings were not expected. Indeed this charge would be good, did not my opinion, whatever it may be, tend to enlighten, and somewhat facilitate the practical proceſs: with the same view, I beg leave to advance another observation, which was the first that led me to an inquiry concerning the means of confirming the object of my present research.

In the neighbourhood of the public buildings, where nitre is prepared, the earth from which it was previously extracted, is eagerly sought after by our skilful farmers, and bought up at any price: this earth, though washed several times in order to be deprived of all its salts, is employed with wonderful succeſs for the improvement of the poorer soils. My attention was particularly attracted by some meadow-ground, which though naturally quite barren, threw up a prodigious exuberance of graſs, after having been covered scarce an inch thick with this earth; a virtue which it is discovered to continue several years afterwards.

Led by this observation, I employed the same earth in its natural state, that is still pregnant with all its nitrous salts; and it is easily credible, that the vegetation was proportionably greater: my researches were therefore directed to the discovery of the very component principles of this earth; and to find out, if it were poſsible, to multiply and convert it into an economical use. This earth I found to be but of the common kind, mixed with some remaining vegetable and animal substances, which were first totally decomposed in it. The particular circumstance I observed was, that this earth was long kept from rain, and from the immediate action of the sun. It is generally known, that this is the superficial earth which is to be found in the stables of our farmers, *(Italy)* particularly where once a year it is unrelentingly picked up by the manufacturers of salt-petre; to whom that branch of public produce unfortunately is here farmed out by the sovereign *. How easy it is to obtain it every where, and in a prodigious quantity; it is therefore sufficiently evident, we need but unite together in a proper manner, and proportion its elements, which lavish nature affords us every where: we may imitate in our exertions what we observe to happen by chance. It is evident also, that all our care ought to be directed to facilitate the generation of nitrous salts; and from what I have hitherto advanced in a confused manner about vegetation, it results, that this new manure will be so much the more productive, as it contains a greater quantity of salts.

I will not farther exhaust your attention with an idle quotation of different opinions on the generation and nature of nitrous salts. The above-mentioned Mr. Macquer has abundantly treated of that article; and several other celebrated authors have lately extended their inquiries even to a greater degree on the same subject. Among the number, the Chev. Lorgna and Mr. Thouvendal ought to be distinguished for the accuracy of their experiments, which throw the greatest light on this matter. The general result of all these observations is, that the generation of nitrous salts seems to be infinitely favoured by a slow and total decomposition of animal and vegetable substances, particularly when mixed together, and combined with a sufficient quantity of earth, being always exposed to the action of the air, kept in a proper degree of humidity, sheltered from rain, and inacceſsible to the sun beams.

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* The Republic of Venice.

We shall follow, with scrupulous attention, all these particulars in the following method.

To those farm houses where it is poſsible, it is sufficient to join a thatched shelter, or shed, which may be easily done, by extending the roof, and supporting it with props: the side opposite to the north is to be preferred. Under this roof, must be contrived a kind of a floor, not quite so wide as the area of the shed; this may be done by forming a frame of uſeleſs timber, and throwing acroſs it such beams as will support the weight of the manure; on these must be placed brushwood or branches, to prevent the paſsage of the dung, and increase the circulation of air from beneath the foundation, being about six inches above the ground.

A layer or stratum of good earth is to be spread over this floor, above a foot thick; this earth may be taken any where, provided it be neither a mere sand, nor clay, nor gravel; in which case, if no better earth were to be found, it would be neceſsary to begin by mixing the one with the other; over this first layer, stable dung is to be laid on of the same thickneſs, or somewhat thicker, particularly if it be very dry: to this succeeds a new stratum of earth, not altogether so thick as the first, then dung again, and so on succeſsively, while the height of the shed permits. It is, however, to be observed, that in order to allow a free paſsage to the air through all the inmost parts of this maſs, it is neceſsary to lay between the different layers of the dung and earth, some loose branches of small wood, or reeds, or else to contrive some holes throughout the entire maſs, in every direction. In the very centre of it, it is very easy to contrive a constant paſſage for the air, by fixing on the centre of the floor, or of the first layer of the earth, a faggot of small wood as high as the roof, around which the dung and earth should be spread in the afore-mentioned manner: by these means the air will penetrate from the top to the bottom, as well as horizontally acroſs the several layers of the whole maſs. To the same end it will be neceſsary never to place any side of the dunghill to a wall. According as the dunghill grows high, attention must be paid to defend it from the heat of the sun, and from the rain, by covering its exposed sides. When summer draws very nigh, and an obstinate heat dries up every thing, the whole must be kept in a proper degree of humidity, by sprinkling it all over with water; but it would be far preferable to sprinkle it with the urine of cattle, which may be obtained from the stables.

In default of this, pit, or cistern water, in which some vegetables and animal substances have been previously putrified on purpose, will anſwer best; ashes, leaves, turf which grows useleſs in some places, putrified weeds, soot, lime, mixed with earth, &c. afterwards with dung, in the above-mentioned manner, will increase the strength of the new manure, and render it still more favourable to vegetation.

When the dunghill has reached its utmost height, it must be left as it were to rest, and another constructed with the same care and attention. But it will be said, are we to squander away our money in building up roofs for dung? and what is still worse, will you leave our fields without their ordinary manure? This would be a loſs not to be made up by any future, though greater, advantage: The landlords must be paid, and we are obliged to strain out of their lands as ready a profit as poſsible.—Such is the language of our farmers, who are generally as obstinate in following their ancient practices, as our landlords are ignorant of their true interests. The generation of salts is the work of time, and there is no other shifts to have recourse to; it is neceſsary, therefore, to construct a second dunghill, in order to let the first repose.

An insulated place, not very far from the stables, is now to be chosen; there a square space of ground, as large as the quantity of dung may require, is to be marked out; and at each corner a perpendicular post is to be planted, and firmly fixed into the ground: these posts can be as high as one thinks proper, but the higher the better. A quadrangular roof, covered with straw, or any other kind of thatching, is to be constructed as wide as to cover entirely the afore-mentioned square space: this roof ought to be moveable up and down the four posts; its corners, therefore, are to be contrived in such a manner as to coincide with and be supported by the same posts. In order to do it, several holes must be pierced through the four posts, at equal distances from the ground, and perfectly corresponding with each other, in a horizontal and parallel direction. Four moveable pegs of wood are to be put into the four corresponding holes, and the roof placed on them. By these simple means it is evident, that the roof can be fixed higher or lower, as occasion requires. The four posts must be tied together, at their highest extremities, by means of four pieces of croſs wood, in order to keep them parallel to each other in all their length. This is the second

Coloſsal fabric to be raised, which, let it be as large as it may, will cost but very little, and last several years.

The posts must be made round and smooth, and the corners of the platform must be kept to them by small hoops, or pieces of rope, loose enough to move, on the top of each post a common block or pulley may be fixed, through which ropes tied to the corners of the platform can paſs; by this means, the roof will easily be moved, and by the hoops at the corners be kept to the posts; at the bottom of each post, the pullies can be tied, and the roof kept to any height; the pegs may also be left, as the pullies can serve to raise up the dung in baskets, or otherwise. Of these sheds, many are to be seen in the province of Padua, where they are made use of for keeping hay, and other kinds of fodder.

Under this new shelter the same operation as before is to be repeated, and the moveable roof to be heightened according as the dunghill grows higher; care must be taken again to cover all round the sides of the dunghill, by some easy contrivance, so that driving showers and scorching sun be always kept out. If a hundred dunghills were to be constructed, a hundred times the same rules should be strictly observed. This only I shall advise, that if some awkward ploughman should be at a loſs how to carry the earth and dung to the dunghill, when it has reached a certain height, an inclined plane may be easily made of some thick planks, boards, or timber, which, with one of their extremities, should lean on the summit of the dunghill, and the other be fixed to the ground; if the planks are not long enough, they may be joined together, and supported by some stays or props underneath the whole of their inclination, particularly where they are connected with each other. There is no dunghill of such a height as not to be reached by the lengthening out of such an inclined plane or bridge. It will be superfluous to say, that the place of the dunghill ought to be liable to no inundations; in every case, superfluous water carries off saline particles. It is also an useful precaution to plant round the place, if there be none, some trees, as willows, poplars, elm, in order to keep the air fresh, and serve as a shade in summer. In the period of a twelvemonth, very seldom before, a slow decomposition changes the whole maſs into an almost homogenous matter; and, indeed, when the dunghill is pulled down, and stirred a little, an earthy substance presents itself, quite like the earth from which nitrous salts are extracted. This is the intended manure, and nothing is now wanted but to employ it to fertilize the soil; every one may try its good effects, and compare them with those derived from the ordinary manures. But who does not perceive the difference? the earth employed in this compound, though barren before, is itself transformed into an excellent manure, not only by its favouring the slow decomposition of the animal and vegetable substances, which is so neceſsary to the generation of nitrous salts, but by becoming itself, in a certain quality, the element of a particular kind of nitre, known under the name of nitre of an earthy basis. It concerns not the husbandman that the fixed alkali alone be the basis of the salts which are to be formed in this manure; vegetation is, as it seems, equally favoured by both. The case is different with respect to those who would wish to extract from their manures nitre, properly so called, and fit for detonation. A variety of precautions, and particular care, are to be observed for this operation, on which I shall add some words hereafter, considering it as an article intimately connected with what I am treating of, and as very advantageous in our rural economy. In the mean time, we see how wonderfully extensive the source of artificial vegetation is in the very same ground, which sometimes we tread upon with contempt; and we cannot but infer what a greater quantity of manures, and far more useful than the ordinary ones, may be easily got by any of our farmers, by following the method indicated above. This however may be farther improved, and, I am unwilling to think, that I should abuse the attention of the most skilful husbandman, in adding some further advice on the subject. The common earth to be employed in making up the new dunghill may receive such a preparation before, as to be better qualified for giving rise to saline elements; for this purpose, it is very useful to spread it in the stables, and leave it there, to be steeped with excrementitious matters, and afterwards to be made use of in the dunghill; this is particularly to be done in winter time, in the stables of sheep and young cattle, as calves, heifers, and colts, which remain always loose, and therefore may trample down minutely the earth and straw, or other vegetable litter, which is neceſsary to spread over the same earth: earth alone would perhaps answer the purpose, if spread quite dry: as to sheep, we must be particularly careful not to let them lie on a bed wetted with their own excrements; it is neceſsary, therefore, either to clean out the stable every day, or to put and spread a new layer of dry earth as soon as the first is wet, and so on. By these means alone, I have seen, in the public manufactory of saltpetre at Verona, the very earth which had been some time before deprived of them, by the custom of washing, as above described, impregnated again with a wonderful quantity of nitrous salts. In the stables of oxen and horses, which are tied to their stalls, a different proceſs would produce the same advantage. The places where oxen and horses stand and lie on, must be contrived in such a manner, as to be a kind of recipients to be filled up with dry earth, upon which the ordinary litter is to be laid; this earth, when moistened, must be dug up, and made use of in the dunghill. The dust collected on the high-ways in summer time, answers those purposes extremely well, where local circumstances permit it to be got. The mould of ditches, the mud of ponds, pools, and stagnant waters, are very useful, instead of common earth, to be employed in the layers of the dunghills: all these matters contain a great deal of vegetable and animal substances, putrified, and are apt long to keep a proper degree of humidity, which is always found when the dunghill is neither dripping nor quite dry; both these inconveniencies may be avoided, by mixing in the layers dry earth, with oversteeped dung; or humid earth, with dry dung. We have seen how this degree of humidity is to be kept, when the whole maſs stands already constructed. By these little attentions, and others, which the avowed principles of vegetation may suggest, it is quite evident, that at the same time, while a far greater store of manures may be prepared, a leſser quantity of it is to be employed in fertilizing the soil: and as for its extraordinary increase, I do not intend to forward any amplified and imaginary aſsertions. It is a fact, says the above-mentioned Mr. Macquer, that a small portion of a putrefactive matter, as a twentieth of it, distributed and mixed with an earth of a calcareous, light, or porous nature, may, with the concurrence of the circumstances acquired by putrefaction, be totally decomposed, and, in leſs than a year, be deprived of every putrid scent, and then afford nitrous salt.

I have said, that this manure may be carried to the field after a year's rest; this, however, is to be understood as the shortest period, and, I may venture to say, that it would acquire far greater strength, by remaining undisturbed for a longer time under its roof.

In the manufactories of nitre, similar dunghills are considered as the principal means of the artificial production of saltpetre; they are pulled down after two, and sometimes three years; and this last period is observed to be the most favourable to the generation of salts. I need not say, therefore, that it would be worthy the care and patience of every husbandman, who has a right notion of his real interest, to build up several of the abovementioned roofs and dunghills, in order to wait for the most advantageous opportunity of making use of his manures. To farmers of this kind, I would recommend also to mix and stir up several times, at intervals of ten or twelve days, the dunghills when pulled down, before they carry them to the fields. This operation, too, is another of the chief practical rules for nitrification in the manufactories, and is often repeated before the washing of the nitrous earth.

But here a charge is perhaps brought forwards against me, and I am told, that I should be highly deceived, were I to think the practice of sheltering dung to be a new one; very old indeed, and well known is such a method. I know it; but it is very far from being universally practised in any country of Europe; far different rules are prescribed for it: to throw, for instance, dung into sunk pits, however sheltered, is an enormous prejudice, though recommended by some of our most eminent rural economists *. The whole maſs buried becomes so condensed, as not to admit that paſsage of atmospherical air neceſsary for the decomposition of the different elements, and for the formation of salts.

I shall, perhaps, be told, that I intend to transfer to an agricultural use what is almost the mere proceſs lately followed in the artificial making of saltpetre. Be this true or false,

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* Corso de Agricoltura Pratica. Firenze, 1787, p. 103.

I shall only say that nobody has hitherto made the application; and I am of opinion that no useful system deserves leſs consideration merely because it is not strictly stamped with the identical features of novelty.

Before I dismiſs this subject, I cannot help repeating, that the longer the nitrous earth is kept, the greater will be the produce of its salts: but let us suppose that the new manure without this attention could never afford such a quantity of salts as the nitrous earth picked up in the stables, or as that which is artificially prepared, with farther care, in the public manufactories; it would be unwise, on that account, to despise and neglect this new branch of easy produce. And who does not know, that industry may, by degrees, reach a farther perfection, even in the hands of the peasant, if fostered by well-timed and just rewards?

A considerable advantage in the method of preparing my manure, is the sparing of labour and time, in carrying and spreading it over the fields. Its great activity in a smaller quantity is the cause of it. There would be certainly no occasion to drag along by dint of horses or oxen, either a very ponderous maſs, trickling with superfluous humidity, or an useleſs mixture of straw, and exsiccated dung.

I shall not leave unnoticed another signal utility, which is the avoiding of some dangerous diseases, and the providing of course for the very precious health of the cultivating part of mankind. A celebrated Physician * justly complained of the absurd ordinary manner of keeping dunghills, as extremely injurious to the health of country people. The rapid fermentation of substances purely vegetable and animal, in which a good deal of water often stagnates, forms around, in summer time particularly, a wide atmosphere of putrid exhalations extremely unwholesome, and the inconvenience is much increased, by the dunghills lying very near the farm-houses, and other inhabited places,

Putrid diseases in summer, if they do not originate in this only cause, cannot but be rendered more dangerous by it. These exhalations may, perhaps, be looked upon as not far diſsimilar from marsh miasmata, and there-

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* Tissot.—Avis au Peuple.

fore it is not improbable that they may also afford a fomes to periodical fevers *.

In the new method, on the contrary, a slow decomposition of the animal and vegetable substances, which is followed by the formation of salts, leaves no room for the operation of dangerous vapours. Nobody ever thought to complain of the insalubrity of the manufactories of saltpetre, where several dunghills made up after the manner described, are standing at the same period under the same roof; and indeed there is no mischief experienced on this account, nor even any unpleasant smell to be perceived.

I shall not here point out any particular mode of employing our manure in the different branches of rural economy. Let it be considered as a repository, that no husbandman, who knows the benefits arising from superficial drefsings, ought to be without.

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* This may happily not hold in England, whose heat of summer never reaches such a degree as in Italy.

# ESSAY XXV.

## *On Parmasan Cheese.*

PARMASAN CHEESE is made in sizes of 60, 80, 100, and even of 180 pounds weight. This depends on the number of cows poſseſsed by the farmer; in general cheeses of 60 or 80 pounds weight, have a quicker sale than those which exceed these weights, because they are more suitable to the greater number of purchasers.

When a farmer poſseſses himself, or in partnership with his landlord, from 60 to 100 cows he makes cheese in his own dairy. Smaller farmers, or landlords, who have but few cows, and who, on account of the expenses attending cheese-making, cannot support an opposition to those first mentioned, unite several together in order to fabricate these cheeses in common, or sell their milk to a contractor, who makes them on his own account.

In the summer time when it is warm, and the milk abundant, a cheese is made every day; in the winter the milk will keep, and a cheese is made every other day. In summer, they skim in the morning the preceding evening's milk; and about three o'clock in the afternoon, that of the morning, and these two maſses of milk are employed together in the making of the daily cheese, which they set about directly afterwards.

All the milk destined for one boiling is put into a large boiler of red copper, three feet eight inches deep, and nearly of that diameter at the top; the size of it will depend on the weight of the cheeses you intend to make. This boiler is suspended by its handle on a moveable arm of wood, which turns by a pivot on its own axis, so that it may be moved off the fire at will, when the temperature of the milk is sufficiently warm, and then replaced on it when it shall want more heat. The fire-place forms a sort of furnace, between which and the boiler the flame may mount; but this furnace is open at one side to allow a paſsage for the boiler when you turn the moveable arm. The fire-place, and even the boiler, are placed a little lower than the floor of the room, in order that the dairy-maid may have greater facility of plunging her arms to the bottom, whenever there may be occasion. When the milk is in the boiler, the fire is lighted to warm it, and to raise the heat to about 120 degrees, (Farenheit's thermometer); I say about 120 degrees, for when we saw this operation we had no instrument with us to measure the heat. The milk is agitated from the bottom to the top, in order that the heat may be equally distributed through the whole maſs. During the time the milk is warming, the dairy-woman employs herself in making butter.

When the milk has acquired the proper degree of warmth, the boiler is taken off the fire, and that the fire may not affect it, a wooden screen is placed between it and the fire-place, to prevent the milk from receiving more heat, and that the internal motion may be kept up. You wait for five or six minutes, that this motion may cease, which is caused by the difference of the degrees of heat of the milk, and when it is quite calm you add the rennet in the manner following.

You have, in a small cup, some good rennet; you take from it a small piece about the size of a walnut, which you put in a linen bag that you plunge into the milk, and rub it well with the hand. The linen serves as a sieve, and retains all the non-diſsolvable matter. When there remains nothing more than this in the bag, then take it out of the boiler, and stir the milk well about, that the rennet may be properly mixed. That done, it is left quiet for the whole maſs to curdle. During this time, they finish making the butter,

In about an hour, or three quarters of an hour, the curd is formed. They prove it, by cutting the maſs with a wooden skimmer, to see if it has lost its fluidity. The screen is then moved, and the boiler replaced on the fire, to heat the milk again, to a warmth which we estimated about 150 degrees. The object of this second boiling seemed to me to give the curd the power of contracting itself, of which I will speak by and bye. During the time it is upon the fire, it is stirred well about, in order to divide it. This boiling which it undergoes, makes it thicker, and adds to its specific weight.

It is suffered to sink a little; and they decant from it about a quarter of the whey, to allow the remainder the means of acquiring the heat of about 180 degrees. It is then continually stirred about, to divide the curd into very small grains. When it has acquired the proper heat a few pinchfuls of saffron are thrown into it, to give the paste of the cheese that yellow colour which is admired.

It is said, this is the sole use of the saffron, and that six months after the cheese is made, the smell of the saffron is entirely dissipated.

It is in this operation of boiling that the principal workman seemed to us to pay the greatest attention to his work. The boiling gives not only the faculty of each particle adhering to each other, like as it hardens the white of an egg, but also to contract itself when it is in a body. It is poſsible that there may be, in regard to this, a certain limit which should be reached, but not over paſsed; it is at least certain that at this period of the manufacture, the workman makes frequent trials; for this end, he collects in his hands some of the curd, which he may easily do, because the maſs is continually stirred about, he squeezes it strongly and finds by this, if it has arrived at the proper point of being able to contract itself. When he is satisfied with the situation of the substance, he withdraws the boiler from the fire, the wooden screen is again placed before it, and the fire is even entirely put out, by throwing cold water upon it.

As they cease from stirring it, the curd quickly precipitates itself to the bottom. They then with large wooden veſsels take out almost all the whey, and throw into the boiler about two pailfuls of cold water, to lower the heat, and to permit the workman to plunge his hands into it. Then keeping his thighs close to the sides of the boiler, the workman bends over, that his hands may reach the bottom; in this position he gathers quickly all the curd to one side of the veſsel, and making haste to put a cloth under the curd, he collects it together by taking the four corners of the cloth, and draws it up, holding the four corners tight in his hand. This maſs is of a very great weight, and probably he may not be able to draw it directly out; in order, however, to do so, he returns into the boiler, all the whey which they had before drawn out, which, however, must be done with care, to avoid burning the workman's hands, who holds the cloth. As the veſsel fills, the maſs of curd can be easily raised to the surface, and when quite full, the workman rises the curd, which he carries quickly in the cloth, and places it in a round mould without a bottom, upon a plain and strong table.

All this last part requires to be done with very great quicknefs, and being much accustomed to it; for the power which the mafs has acquired of contracting itself, causes it to harden very suddenly, and it would form an unhandsome figure, if care is not taken to prevent it.

When the curd is put in the mould, the cheese has already gained such a degree of firmnefs, that you may prefs it strongly with the finger, without its sinking in or leaving any mark. It keeps hardening more and more without any external prefsure being made use of, and it exprefses, by its own natural contraction, the greatest part of the whey, which it had yet retained. The same power which it has, would have the effect of giving it a spherical form; but in order to flatten it, which renders it more easy to handle, they cover it with a round plate of iron, loaded with a heavy stone. It it left during the night in this state, it then cools, and takes the figure which it is to keep after it is entirely cold.

in which no man has a right to ask him any questions, which is a great advantage where game is tolerably plentiful: he has also the advantage, (of much greater consequence,) of having a property, which in its nature, from its low rental, must be improving; a point that has been found, in all purchases on low rented soils, of vast profit to the buyer. Besides this he may, from the low value of land, form improvements, by planting, (highly profitable and agreeable,) upon a larger scale, though at the same expense, than upon the richer soil; which being at so high a rental, can of course admit of little or no improvement, nor be spared for any other purpose, without a great annual loſs for every acre. This observation holds so true, that the lower the rental, the more advantageous; at 2s. 6d. an acre, he gets 1400 acres for his 6000l.; and though he gives 40 years purchase, a very high rate, still he will have 1200, a most desirable thing for such a sum as 6000l.

All this reasoning is applicable to the disbursement of any sum of money; as much to laying out 500l. as 10,000l. Upon the smallest scale, it is far more beneficial to have 80 acres at 5s. than 20 at 1l. yet both will cost, probably, about 600l. And I should also add, that tracts of land are sometimes to be had at 35 years purchase, let no higher than 1s. 1s. 6d. or 2s. an acre, which are the best of all purchases.

Whatever a man's views in his intended life may be, this part of his conduct should still be the same: every person living in the country upon a system of economy, will find, that a certain portion of farming is eſsential to the plan; for if he has to go to market for every thing which a farm produces, he had better live in a town, where he need not keep men and horses for the mere purpose of seeing a neighbour, or sending for a letter. Now whether he so regulates his farming, as to proportion it exactly to his wants, so as to have no more land in his hands than sufficient for his house-keeping; or whether he finds it beneficial or agreeable to farm more, still it is equally advantageous to do either upon land of this small value, as he will stand, in his operations, at so much the leſs expense of rent. Nor should it be forgotten, that this low-rented land is generally either sandy or very dry, either of which is a circumstance beneficial in husbandry, as well as agreeable living.

The benefit of purchasing in poor countries, poor I mean in rental, are far from being merely ideal:—for these last twenty years, the instances of great profit by it are numerous. Three or four in South Wales I have been acquainted with, where, in twelve years after the purchase, more land has been re-sold than has paid the whole original purchase, and fine estates retained, which therefore were had for nothing: this has also happened, or nearly as beneficial, though not re-sold, in Devonshire, Cornwall, North Wales, Yorkshire, and the four northern counties. And I shall also observe, that large estates have been made in that period by land-jobbing, most of which have been done by buying in poor countries. Let a man, therefore, have any sum of money to lay out in land, be it little or great, let him, by all means, do it in a country that is low rented.

An objection has been made, which is this: a man who must go to work economically, ought to get things as much done to his hands as poſsible, and be as little of an improver as he can, from the smallneſs of his funds. Upon very rich land, though high rented, great crops are sure to be had without high expenses, consequently such land is better for one who wants to make his little portion of farming subservient to his living. The general idea upon which this is founded is very just, but the instance is erroneous. I have called extreme dry soils poor, more in compliance with the rent they yield, than from any real poverty in them; on the contrary, I should sooner call wet soils, though high rented, poor, if I was to speak only of profit. The gentleman who plans his farming in subservience to his house-keeping, and no farther, will find himself going much cheaper to work upon dry sand than upon wet clay, though the latter will yield finer crops of several sorts. In the husbandry I here speak of, potatoes are of more consequence than any three crops taken together: you cannot have a potatoe upon clay; the culture in perfection is peculiar to dry soils. I know I may be told that there are extreme rich and fine sands that yield as high a rental as clays, but these are only in spots, and not over whole countries, therefore are rather to be considered as exceptions.

Having fixed upon the country, the situation, and the soil, let us next come to the estate itself; first, as to its *form*. Whatever system you go upon, whether buying only a little land to raise neceſsaries, or a great deal, by way of investing your property, a contiguous compact form is a circumstance never to be forgotten. Some estates and farms are of such a form, that it is a considerable deduction from the rent, the principal parts narrow oblongs, instead of squares and circles, and parts detached, cut off by other people's land. If either of these cases happen in any degree, I should reject the purchase, though every thing else induced me to make it. In the laying out a considerable sum of money, it is not of equal consequence; for, in all probability, there is a good tract around the house, and the detached parts may then be let off in little farms.

The estate you purpose buying being inclosed, none of it common field land, or with rights of common over it, is a most indispensable article. In point of agreeableneſs, you cannot raise even mere neceſsaries in the farming way, without doing it under the most unprofitable and disagreeable circumstances: you cannot think of improving your estate—you cannot cultivate a plant which your neighbours do not agree in—you cannot let an acre to a tenant for more than half its value: at the same time such is the spirit of gaming, and such the turn for inclosure, that these sort of estates sell for more than their circumstances seem to admit of, which is owing to purchases upon speculation of inclosing bills. In most open fields there is a predominant proprietor, who is always ready to pick up all lots that come to market, in hope of by and by getting the power of inclosing. But as I cannot suppose my gentleman to come into such a description, I should advise him never to engage in such expectations, because in none will he find disappointment more cruel.

The next thing of which the purchaser should inquire into, is tithe. There are some countries where this is, in almost every parish, taken in kind; wherever it is the case, I should, on every account, advise a gentleman to reject a purchase so circumstanced. It is of much greater importance than people think, great as the prejudice is against it. I have laid it down as a rule to buy on poor land, with a view to improvements by yourself, if it suits you, or by your tenants, or by the natural course of improvement. Now to have a tenth part taken away, not of your original purchase, but of all the money you lay out, is a matter of such a weight and nature, as must injure your whole plan and intention.

Another point which a purchaser should attend to, is the poor-rates, which in some parts of the kingdom run so high, that a landlord is forced to make very heavy deductions from his rent—letting land for 7s. 6d. or 8s., which, but for this tax, would yield him 10, 11, or 12s. When it rises to such an exceſs, it is neceſsary for a man to calculate the loſs he sustains, for he might as well buy land worth 9s. an acre at the price of 12s., as to suppose the poor rates 2s. or 2s. 6d. in the pound, and find them 6s. or 7s.

The buildings upon the estate to be purchased are another article he should attend well to. In this point he is to reflect upon what his views are: if his fortune is small, and the house on the land what he must reside in, he should see that it is sufficient for his purpose, so that he may on no account have to engage in building, or very expensive repairs. Indeed, if a man buys no more land than just enough for yielding him the neceſsary products for his house and stable, then the building will be a most eſsential article, of as much or more consequence than the land itself: and when this is the case, the greatest attention should be given to every thing—the materials of which the house and offices are constructed, the age, state, and condition of them; and that there are all conveniences which will be wanted. In a word, a man that has but little money will never make it go so far as he might do, if he engages in a place that brings him into brick and mortar. If his fortune is more considerable, and he can spare some money for the building account, in proportion, of course, to such surplus, may he dispense with this otherwise neceſsary strictneſs.

In the introductory chapters to Mr. Young's *Farmer's Guide*, he has given some proper directions concerning the disadvantages of roads and foot-paths being common over a farm, which will always be found a great nuisance; also upon the distance from market, the goodneſs of public roads, the prices of labour, &c.; all these, and some other points, deserve attention, but they are not of importance enough to be so expreſsly considered as the preceding circumstances.

Supposing a gentleman to have found an estate which answers to the description he may collect from these cautions, I should advise him to close with the purchase of it, though it be rather dear, rather than buy a cheaper one not equally complete. As to the prices of land, it is no easy matter to give just accounts, or to lay down any rules to be observed in it. But I may observe, that copyhold land (which, however, for obvious reasons, I should never advise a person to buy,) at present, is generally rated from 20 to 24 years purchase; and freehold rises from 28 to 45. The first price is in countries that will admit of no rise of rent, and also where buildings run pretty heavy upon the landlord. From 30 to 34 is the common price where circumstances are neither very favourable, nor the contrary; and when the price runs higher, it is generally where the rent of the land is low, so that a man has a great deal for his money, which is, upon the whole, the most advantageous point of all others. I have known land bought at a guinea an acre which let at

2d. or at 4d. an acre; this is above 60 years purchase.

Lastly; I shall not conclude this chapter without touching upon another circumstance in purchasing, which will often become a matter of consideration. Suppose a man has 2000l. which he wishes to lay out in buying a little estate, or farm; he may be upon the search 20 years before he finds one the price of which is just 2000l. Suppose he meets with one that suits him at 2500l. or at 2700l. what is he to do? If he buys, it can only be by mortgaging the new estate for the purpose. Is this advisable? How far is it advisable? and upon what principles?

The objection to doing it is this. Money invested in land, upon an average of all purchases, will not yield above 2½, or 3 per cent. if a man enters at once into 3 per cent. from his purchase he is very well off. If he raises money upon it by mortgage, he will not get it under 4 per cent.; he, therefore, suffers a loſs of 1 or 1½ per cent. This, in a small fortune, is a heavy article; but there is another that is yet worse: it is a country gentleman being in the practice of paying interest, which is almost the worst situation he can be in. Such gentlemen are very rarely punctual in their payments of interest. The creditor scarce ever teazes him, and he may let his interest run for years without being asked for it, especially if the sum is small. This is what cramps, and at last ruins half the country gentlemen of little estates. It is, therefore, a situation which a man of prudence should keep out of; let him shun the beginning of it, and dread its ever becoming habitual, unleſs the advantages flowing from it very much overbalance the evils I have now mentioned. With men engaged in commerce, or a regular practice of industry, no evils flow from this sort of debts; and we see the greatest fortunes in the trading world made upon borrowed capitals:—this is owing, first, to the general prudence which naturally attends a course of industry; and, secondly, to the regularity of accounts universal among traders; but scarcely ever found among gentlemen.

Such are the disadvantages attending a mortgage:—next let us inquire into the benefits. First, there is the neceſsity of not being scrupulous to a shilling in the size of the farm, otherwise you will never be able to invest your money. If you reject an estate that suits you in all circumstances, but coming to 2 or 300l. more than your sum, you certainly buy the freedom from incumbrance at a price of much more than it is worth, because you must expect to be that sum out of pocket, and, perhaps, much more in making another estate so complete as the one in question. And there are often estates to be sold, in very poor countries; so much more advantageous to purchase than others in rich countries, that a man rather than not purchase in such, had better add to his money by mortgage, than buy in the latter without that disadvantage; because in the first he will be able to make improvements in rent, and otherwise, more than the amount of the interest he pays on the mortgage; whereas in the other, he will probably be able to make little or no such improvements. But the very idea of a man's visiting an estate, and finding the country such as he likes and approves of, the soil dry, and let at a very low rent, the whole inclosed and free of tithe, with such buildings on it as suit his purpose—the very notion of rejecting such an offer only because the purchase is a few hundred pounds too high for him, is an absurdity: the only question is, how far this idea should be carried?

Suppose the ſum of money 2000l. and that it buys 63l. a year, at 32 years purchase *, the very farm which the poſseſsor of the money wants to buy; but instead of such a farm he is offered one of 95l. at 32 years purchase, which comes to 3000l. †; in such caſe, before he accepts or rejects it, he should calculate in the following manner.

| | £. | s. | d. | £. | s. | d. |
|---|---|---|---|---|---|---|
| Rental | | | | 63 | 0 | 0 |
| Annual profit by timber | | | | 2 | 0 | 0 |
| | | | | 65 | 0 | 0 |
| Deduct land-tax at 2s. 9d. in the pound | 8 | 13 | 3 | | | |
| A quit-rent | 0 | 10 | 6 | | | |
| Repairs which the tenant does not | 4 | 0 | 0 | | | |
| | | | | 13 | 3 | 9 |
| Neat receipt | | | | 51 | 16 | 3 |
| Interest of 2000l. | | | | 80 | 0 | 0 |
| Deduct | | | | 51 | 16 | 3 |
| Loſs by investing it in land | | | | £.28 | 3 | 9 |

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* £.2016 † £.3040.

which loſs it is supposed the gentleman submits to for the advantages of a country residence, &c. Now that he may know what he loses by accepting a larger purchase, he should make in his calculation the circumstances to which he is desirous to submit the criterion whereby to judge of others.

| | £. | s. | d. | £. | s. | d. |
|---|---|---|---|---|---|---|
| Rental . . . | | | | 95 | 0 | 0 |
| Profit by timber . . | | | | 3 | 0 | 0 |
| | | | | 98 | 0 | 0 |
| Land-tax 2s. 9d. . | 13 | 1 | 3 | | | |
| Quit rent . . | 0 | 14 | 0 | | | |
| Repairs * . . | 4 | 0 | 0 | | | |
| Interest of 1000l. . | 40 | 0 | 0 | | | |
| | | | | 57 | 15 | 3 |
| Neat receipt - . | | | | 40 | 4 | 9 |
| Interest of 2000l. . . . | | | | 80 | 0 | 0 |
| Deduct . . . | | | | 40 | 0 | 0 |
| Loſs by investing it in land . . | | | | 40 | 0 | 0 |
| Neat receipt in first estimate . . | | | | 51 | 16 | 3 |
| In the second . . . | | | | 40 | 4 | 9 |
| Difference . . . | | | | 11 | 11 | 6 |

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* Repairs in farms do not rise proportionably to the rent, especially in such variations as these.

This difference is the price he must pay for such beneficial circumstances as he may see in the farm offered to him; and between such circumstances and this 11l. 11s. he should, in his own mind, draw the balance. There is nothing in the amount of it which should make it at once a reason for rejecting a larger farm: if it is upon the soils commonly called poor, sandy, and dry ones, the rise of rent probably will more than make up such a difference; and I may also observe, that in many estates that, to my knowledge, have been bought within ten years, the rise of rent has been more than to make up the loſs of taking money at 4 per cent. mortgage, and laying it out in land that did not, upon the first account, give 2¼. This is owing to the ignorance of landlords of the real value of their farms. Buy any estate in the kingdom in the hands of the old tenants, even at advanced rents, and upon your coming into poſseſsion advertise the farms to be let by auction, the rise of rent may probably give 1 or 1½ per cent. interest upon the whole purchase; and if the purchase is made with judgment, more. It is, therefore, but a deceitful view you take of the affair, if you look no farther than the bottom of such an account as this;—it is the succeeding operations to which you must have an eye for giving the advantage. Upon the whole, I think, from 700 to 1000l. in 3000l. may safely be mortgaged for, *provided* in consequence of it you get an estate considerably more suitable to your purpose, than you would otherwise be able, especially in the point of lowneſs of rent. But I always suppose a man who enters upon the country life not from inheritance, but from motives of calculation and prudence, will be consistent enough with himself to consider the payment of the interest of his mortgage as a certain infallible annual one, calling for the same attention and regularity as the land-tax, or any other certain payment.

There is another consideration which the purchaser should reflect well upon in the allotment of his money, which is the quantity of land he purposes to farm; if he designs to occupy any of it, which of course he will for house-keeping, the stable, or other purposes; or if he designs to farm upon a somewhat larger scale, in any case he must make a reserve of 5l. for every acre he designs to keep upon stiff soils, and 4l. upon light ones, by way of stocking his new farm—so that after he has bought his estate, he may not be prevented from continuing his plan for want of the neceſsary sum for executing the idea. This he must be very attentive to, or he will afterwards find the inconvenience of it severely.

These are the great leading objects which most demand attention in making the purchase. There are many inferior ones to which it would be endleſs to adapt directions; they must be left to the common sense and common observation of the person who wants to lay out his money.

A common case with gentlemen purchasing in the country with a view to reside in it, is buying an estate suitable in every respect but that of a house; and building one for themselves. This is a conduct that ought to be very well examined, as there are many reasons both for and against it. I must, however, remark, that gentlemen, whose fortune is very small, ought never to go upon this plan; it is proper only for those who can buy a handsome estate, or farm, and afterwards find cash enough to please themselves in a house.

Plans of conduct are condemned in conversation more from instances of the folly of individuals, than from sound arguments drawn from the nature of the case. Nothing is so common as ridiculing people of small fortune for thinking of building, meaning fortunes more considerable than what I term such in this Eſsay. But this is very absurd, because buildings may as well be proportioned to a man's fortune as any thing else, if he has sense enough to manage it. And when I say that people of little fortune should have nothing to do with building, I mean, by the expreſsion, only such small incomes as will not allow money enough to buy land for neceſsaries, and leave a sufficiency.

If building is the plan adopted, there are two principal circumstances to be considered; building an entire new house, or adding to one already built. If the farm-house already upon the land be tolerably situated, and is a substantial one of brick or stone, tile, and good timbers, it will save a considerable deal to leave it standing, and add three or four rooms to it. This is a plan which will prove much cheaper than building a house and all its offices new from the ground; but if it be neceſsary to make any considerable alterations in the old house, to connect it with the new, then you will find it better to fix upon another spot, and build the whole from the ground new. The instances are numerous of people adding to and altering, and when they have done, find themselves in very bad houses, costing as much as good new ones. This is owing to a want of judgment, more common than one would suppose it.

Whether a new house be built, or an old one added to, I should, by all means, advise the doing either by contract. For a man of but small fortune to engage in uncertain expenses of so dangerous a nature as those of building, is a very great imprudence. Building contractors will agree with you, and securely, for any circumstances that can be described: in this way you have a certainty in your expense—you do not mean to lay out 500l., and find yourself engaged for 700l., or, perhaps, for double what you intended; which is a point of so much consequence, that no motive should engage you to depart from it.

Building, when done by contract, is not so formidable an object as many have supposed. I have known more than one instance, and within twenty miles of London, where six rooms, that is, two parlours, two bed-chambers, and two garrets, have been added to a farm-house, and the latter put into complete repair, and connected with the new apartments, for the sum of 400l.; also others for 500l. But had these been cases of common building, and not performed by contract, it would probably have cost treble the sum.

In the work of building, a gentleman should consider several circumstances; first, the income to be spent in the house when built, the size of the family to live in it, and the company the master designs to keep. It is impoſsible to lay down minute rules for proportioning these circumstances; they must be left to the experience and understanding of the individual. Let me however remark, that there is no family but what will find it both very convenient and agreeable to have one good room in their house: this is a caution which will not be thought unnecessary, when we reflect on the multiplicity of persons who spend much money in building houses without this eſsential. Supposing you provide one large dining-room, and two smaller ones, with five bed-chambers, six garrets, and offices, we may decide the house to be sufficient for an income of from 700l. to 1000l., the family living in the manner which such incomes will, with economy, allow. And as to smaller incomes, I do not think they will allow any great solicitude about the apartments of the house; the most they can do in building, is to add a few rooms to the old farm-house; and that plan can hardly be carried farther than the sum of 400l. or 500l. to form a convenient dwelling; I mean, if a prudent attention to economy is adhered to; but if, through a peculiarity of opinion, a man had rather sacrifice a portion of good living, than not live in a house something too good for his fortune, then he must be satisfied with the exchange:—but one cannot reason upon such peculiarities.

There is another part of building which must be equally attended to by every person who designs living in the country, and farming little or much land, whatever his fortune may be: this is what, in general, goes under the name of offices. It is disagreeable living in the country without having every sort of office, however minute they may be: barns, stables for your own horses, and your team; cow-house, with partitions for calves; pig-sties; poultry-houses for chickens, ducks, geese, &c.; a straw-shed, wood-shed, coal-house, ash-shed, a tool-house, &c.; all these are exceedingly convenient, though you farm but 20 or 30 acres for the support of a small family; equally convenient indeed as upon the largest farm. Nor is it an expensive matter to procure these inferior buildings, the size of most of them being very trifling; and the materials of which they may be built, rough, and of small expense. If you have to erect many of them from the ground, you should, by all means, attend to one circumstance, which will be found a very great convenience; this is to connect the barns, stables, cow-house, pig-sties, poultry-houses, &c., so as to inclose an area for the winter-keeping of your cattle; which, as I observed with respect to the buildings themselves, is as neceſsary, and as useful to the least buſineſs, as to the greatest.

One of the most agreeable circumstances attending a residence on an estate belonging to the inhabitant, is that of gradually making the buildings convenient and agreeable. When a man of but a small or middling fortune lives in another person's place, he is naturally cautious of laying out his money, being an injustice both to himself and his children. But when he lives upon his own farm, he feels a pleasure in doing every thing in a strong and substantial manner, that they may last not a lease, but as long as poſsible: and by doing things well, they are not to be done again; so that by laying out a little money every year, such things are gradually brought to be in good order, and annually improved, which is a yearly addition to the convenience, and consequently to the agreeableneſs of a country residence. And at the same time that the laying out such small sums has this effect at the time, it has also another, of adding to the value of the inheritance for your children; an object which, to all good minds, is a perpetual source of pleasure.

There is something to observe upon the advantage of living upon an estate of your own, either tolerably wooded already, or else on a poor soil, which makes planting one of the best applications of it. By means of having wood for repairs, and little additions to the buildings, they come much cheaper than if you are to go to the carpenter's, not only for work, but timber also. To be able to make a small yearly cutting for such purposes, you will find a most useful and agreeable circumstance. And when it is considered, that upon almost any soil, most of the fir tribe, ash, and poplar, will grow so quick as to come into use for many articles in building, within the term of fifteen years, and be applicable to yet more purposes from the age of twenty to thirty, it will at once appear of what consequence it is to plant a small portion of land every year; especially when there is any probability of buildings, or fences of wood being erected.

There is one building which is by no means general, especially upon little farms or estates, and that is a pigeon-house; yet is it one of the most useful articles in the whole list. The expense is from 30l. to 150l., yet would I recommend it to every gentleman on his own land, as an object of very material consequence on many accounts. In some cases, a middling sized room over some office, not adjoining the house, does very well for a small family; but there is never any certainty of succeeding:

whereas, pigeons rarely fail of taking to a real dove-house, and, with proper attention, of yielding the greatest plenty of pigeons, both for the consumption of the family, and also for sale. There is no expense, if the money can poſsibly be spared, that will pay better than this. Suppose the residence is (as I have all along supposed it to be,) in a distant cheap county near coals, it is twenty to one but it is near lime-stone, building-stone, and slate likewise, and then the expense of a pigeon-house will not be above 30l. or 40l.; the interest of that sum at 4 per cent. is not 40s., but call it so to take in repairs; at 2d. a-piece, 40s. are only 20 dozen of pigeons, whereas, if you manage your house well, you will draw from 80 to 100 dozen in a year; and if the country is a favourable one, abounding much with corn, and not very thickly inclosed, you may draw considerably more.

# ESSAY XXVII.

## *On converting poor Sands, including Warrens and Heaths, into Tillage, and again returning them into Graſs in an improved State.*

POOR sands and heaths are never covered with graſs so as to be called good pasture; of course there can be no danger of making them worse by a few years tillage; such soils, therefore, when corn is scarce and dear, should be the first to be resorted to for an additional supply.

Poor blowing sands, it is well known, have been improved, from little or no value, to be worth from 10s. to 20s. per acre, by coverings of clay and marl; and, when so improved, have produced good turnips, carrots, rye-graſs, and sometimes, (if well clayed,) barley, clover, and wheat. If, after a few years tillage, the dung that has arisen from the land by foddering out its produce to cattle in farm-yards, be spread on it for turnips, and those eaten upon it, as recommended on loamy soils, this kind of poor land will be in a better state to be returned to pasture, than before it was cultivated.

The best method to be adopted, when it is intended to till these poor sands, most of which are apt to blow or drift like snow, is, in the first instance, to destroy all the heath, furze, &c. on the surface, by paring and burning, and then to give them tenacity by a thick covering of clay, which being finished with a good summer fallow, a fine crop of turnips may be expected. By folding these off with plenty of fodder, the soil is made very productive for several years to come, and one of the best rotations of cropping will then be,

Turnips,
Barley,
Clover,
Wheat,

as long as clay and manure can be obtained to keep the land firm and in good heart; but if, from the want of clay and manure, the soil is not sufficiently improved to bear clover, wheat cannot be expected, and must not be ventured upon; but the following rotation may be used instead. Pare and burn for

Turnips,
Barley,
Rye-graſs and trefoil two or three years,
Pease.

When these poor sands have been under one or two of either of these rotations, it is very proper to lay them down again to graſs; but, in order that the best covering of turf may be produced, it is absolutely requisite that it should be done after a crop of turnips eaten off the land by sheep; the soil, being then clean from weeds, and covered with the manure of the sheep, encourages the graſs-seeds to come well, and get full poſseſsion of the land; which, when so managed, becomes a pasture infinitely more valuable than before it was put into tillage. But it must here be observed, that the crops of corn should always be kept as clean as poſsible from weeds, so that no seeds of them be suffered to drop. The corn-marigold and poppy are very troublesome weeds on these sandy soils, and, unleſs kept under, the land had better not be cultivated at all, for the weeds will frequently over-run the crop, and almost totally destroy it. The rich sands, which require a different treatment, are extremely valuable either in graſs or tillage; when in graſs, they are generally well covered with the best kinds, and produce a great abundance of a fattening quality both for oxen and sheep; when in tillage, they are easily cultivated, and, if kept clean from weeds, are very productive in all kinds of vegetables and corn.

Sandy soils, especially if to be returned to pasture, should be ploughed shallow, in order to keep as much of the clay and manure as near the surface as poſsible: five or six inches is full deep enough.

# ESSAY XXVIII.

## *On Ray-Graſs.*

HAVING it in contemplation to sow this graſs, I found that the uniform opinion of the country was against it. There was none sown within thirty miles, or more. One person said, it was a hungry graſs; others, that it was a coarse graſs; another, that it impoverished the land, &c.; but as their opinions did not arise from fact, or actual observation, it was determined to put the matter to the test of experiment, and a field was sown with it, (principally,) in conjunction with white clover, and a little trefoil. The result has been perfectly satisfactory. No hay could be better relished by my horses than this was; not a particle of it was wasted by them, or left in the rack; no animals could thrive, coat, or do their work better, than they did, whilst they had this ray-graſs hay to take to. Never was there a greater contrast, than when they were put to the natural hay-graſs of the country, after they had finished the other. They were literally starved into the eating it, and, in spite of an additional quantity of corn, they fell away, (agreeable to my farming man's mode of expreſsion) a limb a-piece. This year, nothing can look better than my horses do, upon this hay, (with which some red clover is mixed,) and this, with the addition of very little corn, and that mostly light, the tailings of oats and barley.

Upon looking back at the different opinions that have been given of this graſs, it is conceived that they may be naturally accounted for. It has been tried in some situations, and found not to give a thick, well-connected sward. Ray-graſs is natural only to good soils, or those in a fertile state; for, however, it may be found accidentally in those of a contrary description, it will be only where the land has been enriched by dung, or other manure, casually dropped. It comes up spontaneously, for the most part, by the road sides, or near the gate of a pasture field, where the cattle are accustomed to wait. The present summer, a field was observed to be so full of ray-graſs, that, knowing none had been sown in the country, it became a question of curiosity, to discover what circumstances ha occasioned it. Upon inquiry, it turned out, that a large quantity of cattle, for a neighbouring fair, had been folded there a night, who had covered the field with their dung; whence the tendency to produce ray-graſs.

When land is in a proper state of manure, ray-graſs, united with white clover, will form a perfect sward, the latter end of the second year, after it is sown. I have a particular field, of about five acres, that was sown with these two graſses only, that is more perfectly graſsed over than others, which had the addition of trefoil and rib-graſs, and which were sown at the same time.

A neighbour of mine, the only man in the country that had tried ray-graſs, told me it would not answer, and referred me to a particular field, where some had been sown. The fact was, that he had cropped this field with oats, until it was no longer worth ploughing; and then, with his last seed, he sowed ray-graſs, which, certainly, did not flourish. But his argument would have been equally conclusive against any graſs, or grain, whatever. The ray-graſs languished, and, finally, died away, giving place to the vegetation suited to the state of the land. If it be expected that ray-graſs, or any other good graſs, should thrive, and produce abundant crops, on exhausted or poor lands, it must not be in the soil which occurs here.

On converting ray-graſs into hay, it is neceſsary to cut it at a period previous to its being so ripe, as to have perfected its seed, and changed to a yellow colour; for, in this case, a great part of the juices of the plant, which constitute a principal part of the nutriment it is to afford, will be converted into a species of straw, and its nutritive properties be proportionably diminished.

When it is made into hay, persons not acquainted with its qualities, are apt to object to its apparent coarseneſs, which proceeds from its consisting almost entirely of flowering stems, the ray-graſs having a comparatively smaller proportion of leaves than any other graſs. Whether this be a defect, or a merit, will depend upon a solution of this question: Do the stems and flowering parts of graſs, or the leaves, taken weight for weight, contain the greater proportion of nutriment? It does not appear that this has been determined by expe-

d for the purpose: but it
the stems being so much
aves, (which is particularly
chewing them, when about
from those vegetables, which
uch saccharine matter, being par-
y nutritious, that the greater propor-
ate quantity of nutriment will be found to
eside in the stalks; and if so, the advantages of
ray-graſs will be decisive.

But, however this may be, it is certain, that supposing wet weather comes on during the proceſs of hay-making, the first part of the graſs that decays is the leaf, which soon becomes yellow, and then black, loosing all pretensions to nutritive properties; in which case, it is evident, that almost the whole nutriment contained in the hay, must reside, exclusively, in the flowering stalks. Ray-graſs then, has, in unfavourable hay seasons, an advantage over all others, inasmuch, as from having fewer leaves, it is not so apt to be injured by a continuance of rain: and it is, besides, when in the cocks, more acceſsible to the air and wind, from lying more open and light; and consequently, not so apt to heat and mould as other graſses in similar situations and seasons.

It certainly poſseſses the following valuable properties: 1st, That there are few graſses so early in the spring. 2d, That there are none better relished by cattle, nor more nutritive. 3d, That it has the power of resisting the effects of bad weather, in ticklish hay seasons, in a greater degree than other graſses. 4th, That there is a greater facility in collecting its seed, than of any other graſs.

The prejudices against it appear to have arisen, 1st, From its having been sown in land not capable of producing a full crop of any good vegetable. 2d, From allowing it to shoot up so far, as to have formed the seed, in the flowering stalk, before cattle have been turned into pasture, or that it has been cut for hay. Ray-graſs appears to partake more of the nature of grain than any other graſs. Hence, when it has perfected its seeds, it shoots out no more stalks, and but few leaves, that season, as Lord Kaimes has justly observed. Hence it is neceſsary to turn cattle into a field of this graſs, early in the spring, and to keep it well under, by a sufficient quantity of stock;

in which case it will continue to put out fresh flowering stalks and leaves during the whole season. 3d, The hay, for the reasons just aſsigned, should be cut before it becomes a mere straw. Common hay-graſs, being composed of graſses in various stages of growth and ripeneſs, admits of a greater latitude than a field of ray-graſs, because many of them will, generally, be in a proper state for cutting, although others may have paſsed their prime.

## ESSAY XXIX.

### *On the natural Climate of Plants.*

Of plants, each species affects a particular soil in preference to every other. In their culture, therefore, it is of the utmost importance to have a distinct knowledge of the *Loca Natalia*, that the nature of the soil in which they are cultivated may be made to approach, as near as poſsible, to that in which they spontaneously grow. This is the solid and proper foundation of planting and gardening:

> Nec vero terræ ſérre omnes omnia poſsunt.
> Fluminibus Salices, craſsisque paludibus Alni
> Nascuntur, steriles saxosis montibus Orni,
> Litora Myrteis lætiſsima: denique apertos
> Bacchus amat colles, Aquilonem et frigora Taxi.
>
> GEORG. ii.

The numerous species of plants which grow betwixt the North Pole and the Equator, when viewed in detail, appear to differ from each other only by insensible degrees; yet are the plants of the frozen zones, when viewed in cumulo, or in a body, totally different from those which are produced betwixt the tropics. Thus we often see whole families of plants, natives of the torrid zone, which are never to be found in any of the others. In the climate of plants, says Linnæus, are to be considered latitude, longitude, and the temperature or elevation of the soil. Vaillant was among the first who viewed the Loca Natalia of plants in this light; but his observations were confined to latitude alone. Places situated under the same parallel of latitude, but in opposite hemispheres, produce plants that are totally different; even those in the same hemisphere are rarely alike. Thus Rome, Pekin, and New York in America, are situated almost in the same degree of north latitude, yet produce very different plants. The same may be said of the plants of Florida and Palestine, the Cape of Good Hope, and Chili in South America, places which exactly correspond in latitude; the two former situated in the northern hemisphere; the latter in the southern. What has been affirmed of latitude, may likewise be aſserted of places that are situated upon the same meridian. Thus the North Cape, Rome, Upsal, the Cape of Good Hope, agree in lŏngitude, yet produce plants that are totally different. The aptitude or disposition of plants to grow in certain climates, and not in others, seems to depend not so much upon longitude and latitude, as upon the elevation of the soil, or difference of temperature in such climates. From this cause proceeds the difference which is generally found to obtain betwixt the plants of the torrid, and those of the temperate and frigid zones. For when in the torrid zone we find the mountains, which, by their elevation, have acquired a temperature similar to that of the temperature of the frigid zones, we always discover on such mountains the same, or, at least, a part of the same plants. Thus the plants on the mountains of Lapland, of Switzerland, Greenland, Siberia, Wales, the Pyreneans, Olympus, Ararat, and Brazil, though placed at such immense distances from each other, are nearly the same. Of this Mons. Tournefort, in his travels into the east, had very convincing proofs At the bottom of Mount Ararat, he found the common plants of Armenia; a little higher up, those of Italy; higher, those which grow about Paris; afterwards, the Swedish plants; and, lastly, on the top, the Alpine plants of Lapland. As at a certain depth, the temperature of water is found to be nearly the same in all climates, so the greatest part of aquatic plants are common to the torrid, temperate, and frigid zones. Thus the Water-lily, *Aldrovanda*, Sun-dew, Arrow-head, Water-milfoil, and many other aquatics, are equally natives of Europe and the Indies.

In every part of the habitable world, the earth seems to be of the same nature, being calculated to resist the extremes of heat and cold. When almost burnt up by heat, it recovers its vigour after refreshing rains; and when rendered an inert lump, in consequence severe frosts, it aſsumes fresh life, when ted upon by the solar rays. Upon this bject, Pliny the Elder expreſses himself in nguage the most pathetic and sublime: It is the earth that, like a kind mother, receives us at our birth, and sustains us when born. It is this alone, of all the elements around us, that is never found an enemy to man. The body of waters deluge him with rains, oppreſs him with hail, and drown him with inundations; the air rushes in storms, prepares the tempest, or lights up the volcano; but the earth, gentle and indulgent, ever subservient to the wants of man, spreads his walks with flowers, and his table with plenty; returns with interest every good committed to her care; and though she produces the poison, she still supplies the antidote; though constantly teased more to furnish the luxuries of man than his neceſsities, yet even to the last she continues her indulgence, and when life is over, she piously hides his remains in her bosom*."

It is remarked by many writers, that the imate of modern Europe is much warmer than that of the ancient; and as a proof of its being so, we need only compare the testimonies of the most authentic and ancient writers with our own observations and experience. The Abbé du Bos observes upon the climate of Italy, that it is warmer at present than in ancient times. He says, "The annals "of Rome tell us, that in the year 480, ab. U.C. "the winter was so severe, that it destroyed "the trees. The Tyber froze at Rome, and "the ground was covered with snow forty-"five days. When Juvenal describes a super-"stitious woman, he represents her as break-"ing the ice of the Tyber, that she might "perform her ablutions:

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* Plin. Nat. Hist. l. ii.

> Hybernum fracta glacie descendet in amnem,
> Ter matutino Tyberi mergetur.

"The Poet speaks of the freezing of the river "as a common event. Many paſsages in "Horace suppose the streets of Rome full of "snow and ice. We should have had more "certainty with regard to this point, had the "ancient Romans known the use of thermo-"meters. But their writers, without intend-"ing it, give us information sufficient to con-"vince us, that the winters are now more tem-"perate there than formerly. At present the

"Tyber no more freezes at Rome than the "Nile at Cairo. The citizens of Rome esteem "the winter very rigorous if the snow lies "two days, and if one sees for eight and forty "hours a few isicles hanging from a fountain "that has a north exposition." Pliny the Consul, in his letter to Apollinaris, in which he describes his villa in Tuscany, says, that it produces bay-trees in great perfection, but that sometimes, though not oftener than in the neighbourhood of Rome, they are killed by the sharpneſs of the seasons. Ovid describes the place of his banishment, Tomus, on the Euxine sea, as enjoying a most rigorous winter; but Tournefort, who visited the same country, says, that there is not a finer climate in the world. He remarks, that nothing but Ovid's melancholy could have induced him to paint the country in such horrid colours. But I think the facts mentioned by the Poet are too circumstantial to admit of such an interpretation.

# ESSAY XXX.

## *On Hiring a Farm.*

THE farmer who wishes to rent a farm, should, upon such an occasion, call forth all his abilities. He should equally attend to the disadvantages, as well as to the advantages of the farm,—that he may be able to draw a balance, and compare that balance with the rent demanded. Let him remember, that he must equally diſcard a too solicitous prudence, which doubts every benefit, and a too daring courage, which overlooks, or leſsens every evil.

It must be obvious to almost every person, that the common farmers often lose themselves in deliberating concerning a farm. They have so many mistaken rules of judging, that they often reject farms, that soon after make the fortunes of such as hire them. In particular, they are very apt to take one false guide, the succeſs of the last tenant. If a man makes a good deal of money upon a farm, or leaves it for a much larger one, numbers will immediately apply, almost without viewing it; but, if a tenant or two breaks, or is poor, most of the neighbours look down upon it, without further consideration. They attribute all to the land, and avoid it, under an idea, that without a reduction of rent, the farm cannot be profitable. These notions are absurd in the extreme; for the management of various farmers is so eſsentially different, that succeſs often depends very little on rent. A farmer, with a proper sum of money in his pocket, hires a farm, and thrives upon it; another, with an hundred pounds leſs, hires it, and starves. Suppose two farmers of the same substance, and living upon similar farms: one manages his land with judgment and spirit; makes all the manure he can; sells no hay or straw; does not injudiciously crop his land; drains his fields, and keeps his fences in good order. This man grows rich. The other, a sloven in these particulars, falls into poverty. These are the circumstances that make one man rich, and the other poor; the rent has but little influence. And surely it must be apparent, that succeeding occupiers, judging of the respective farms, by the succeſs of others, are taking as blind a guide as they can poſsibly fix on.

Let the farmer who is debating whether he should hire a farm that is offered him, examine the soil well, that he may be enabled to determine its nature, as to stiffneſs, moisture, exposure, levelneſs, slope, stoneneſs, &c. What draining, manuring, and fencing will be required: let him take into consideration the roads, distance of markets, prices of commodities, labour, &c. If tithes are taken in kind, it perhaps may be a prudent measure to reject the farm entirely. The compactneſs of the farm, and the situation of the homestead, should be well considered; together with the poor-rates, and all out-goings. Let him deliberate upon all covenants relating to the manner of cropping the lands; for such are often in direct opposition to improvement. One general rule, in hiring a farm, should never be forgotten: Let the farmer fix upon good land, and he can scarcely pay too much for it; but, for poor land, the least rent is too high. By poor land, however, we are not to understand such as have the command of lasting manures, as marl, &c.; neither are we to consider land as unprofitable which paſs under the denomination of *waste*, for such are often very rich.

These are considerations of great importance. The mellow, rich, putrid, crumbling clays, or rather clayey loams, are, of all soils, the most profitable: Regard such as will admit of being ploughed soon after rain, and do not cake on hot gleams of sun coming soon after; lands of that quality are cheaper at twenty shillings an acre, than others at five shillings.

Another consideration of great importance is, not to take a farm that may require more money to stock it well, than the farmer is in poſseſsion of. Farmers are usually very eager after quantity; the certain consequence of which is, a slovenly system of management. A farmer loses much when he is obliged to desist from a work, which he knows to be right, in consequence of a want of money; and he can only prevent such a situation, by hiring no more land than he can manage in a masterly manner. Let any one consider the difference between good and bad husbandry in all its branches. The one is a certain loſs; the other a certain gain. A profitable and proper use of natural manures, as marl, clay, chalk, &c, can only be made by those farmers who have money at command. In the neighbourhood of great cities and towns, a variety of manures are to be had, and in some places at a reasonable price; but without the command of money, how are they to be obtained?

As in land, so in manures, quality is to be considered above quantity; but this is a distinction that many farmers are unable to make, and yet it is a thing of the utmost importance. Animals require food of a good quality, and they reject that which is bad; but vegetables, being of a paſsive nature, they can only show their dislike by a feeble and unhealthy appearance when growing.

To be able to purchase manures of a rich and good quality, a farmer should choose a situation within a reasonable distance of a large town, or near a navigable river. I mean when he can make such an election; for it is not in the power of every man to rent a farm so advantageously situated.

Let the farmer ever hold in remembrance, that manure is the life and soul of husbandry; and he that knows how to make it, and afterwards how to apply it, cannot fail of being a succeſsful farmer in any situation.

# ESSAY XXXI.

## *On Drilled and Broad-cast Wheat.*

HAVING heard much said in favour of Cooke's Drill and Horse-hoe, I was determined to make a comparative experiment on a twelve acre piece, one half of which was drilled, the other half sown broad-cast. In June 1790, the above piece, a mixed soil, or gravelly loam, was ploughed one furrow from a two-years graſs layer, and sown with turnips. The turnips being taken by the fly, I converted the whole twelve acres into a fallow for wheat, by twice ploughing, three times harrowing, and once rolling. On the 12th of October, the land was measured and equally divided; on the 14th began to sow broad-cast under furrow, with the usual quantity of this country, viz. two bushels and a half per acre (our bushel is eight gallons and three quarts measure:) on the 15th, finished the broad-cast: the two following days, the six acres intended to be drilled, were ploughed (in order to give both an equal quantity of work) into lands nine feet six inches wide, a proper width for Cooke's Drill, and drilled accordingly, a few days after, with one bushel per acre of the same measure as above. To do the drill justice, I must observe that the young plants suffered very much from the rooks picking the grain out of the drill, which left the land so thin of plants, that some of my neighbours went so far as to say, I should have no crop: it was also, I believe, injured, one acre in six, by a leading land-ditch stopping, which overflowed that part of the field with water for some time, and being directly acroſs the lands, hindered me from scarifying so soon as I would have done.

During the winter the broad-cast had, by a great deal, the best appearance; but in a little time, after the drilled wheat was scarified, which was done the second week in March, it evidently got the lead, being then of a darker green, and more healthy colour. In April the drilled wheat was horse-hoed; at the same time the broad-cast was hand-hoed; and in May the drilled wheat was hand-hoed, as at that time I had not a horse-hoe of my own, nor could I at that time borrow one. The drilled now beat the broad-cast much; it tillered well: I told from twenty to thirty stems from a single plant with wonderful ears, containg from ninety to one hundred kernels in one ear. The broad-cast became ripe first; but both were cut at the same time, that is, the same men cut the drilled immediately after it: the broad-cast was carted two days before the drilled; but both were got without any rain, and laid in the same barn, with a layer of drag-rakings between them, in order to thresh them separately.

Both crops were threshed by the same men with great exactneſs. The produce of the six acres drilled, was twenty-five quarters, six bushels; the produce of the broad-cast, twenty-four quarters, one bushel and a half. Produce of the drill per acre, thirty-four bushels, one peck, and four quarts; produce of the broad-cast per acre, thirty-two bushels, one peck: that is, two bushels and four quarts in favour of the drill, which, with one bushel and a half of seed saved, is three bushels and a half and four quarts, which may be estimated at about twenty shillings per acre, in favour of the drill. This, though considerable, is but trifling, compared with the benefit the land has received from being scarified and horse-hoed, which was very visible when the crops were cut, the drilled stubble being very clean, and the broad-cast foul.

The expense in the cultivation of the two crops was nearly the same. The drilled wheat was once scarified, and once horse-hoed, at eight-pence per acre each time; also hand-hoed at three shillings and six-pence per acre. The broad-cast was hoed at five shillings per acre. I must here observe, that it is not usual to hand-hoe broad-cast wheat in this part of the country, though practised in some parts; but, in order to be satisfied, and to make up my mind about drilling, I determined to run the drill hard, by doing what I could to the broad-cast; and I am decidedly of opinion, that if I had not hoed the broad-cast, and if the drill had not suffered by the rooks, and by being overflowed with water as before-mentioned, the drill would have beat the broad-cast at least one-fourth part.

# ESSAY XXXII.

## *On Tithes.*

IT may be right to premise, that I consider tithes, in the hands of the clergy, as *the property of the state, appropriated to the maintenance of the ministers of the established religion of the country*. And, in order to explain myself as distinctly as I can on this subject, I will state to you the following case, taking such numbers as are easiest in computation, without considering whether they expreſs the proportions which usually obtain in fact:

An estate is purchased, value 100l. a year, at 30 years purchase, 3000l.; the titheable produce shall be supposed equal to three rents, 300l. The tithe 30l.

The farmer pays then to his landlord 100l. and to the parson 30l. the *whole rent* of the land is therefore 130l. To have purchased the estate tithe-free, the landlord must have paid 3900l. instead of 3000l. The landlord, certainly, is not injured by not receiving from his land the interest of 900l. which he never expended on it. Indeed nothing could be more unreasonable, than if he were to receive it twice over, both in the form of interest for his money, which he has never parted with, and of produce from his estate, which he never paid for. If he would have his estate freed from tithe, without paying this additional 900l. he should be content to give up a part of it in the proportion of 30 to 130, that is $\frac{23}{100}$, or somewhat leſs than a $\frac{1}{4}$, such part being, properly speaking, *not his own.*

The tenant is not injured, because he has calculated the rent which he is to pay to his landlord, taking the payment of tithe into the account. If there were no tithe, he must pay 130l. to his landlord, instead of 100l. to the landlord, and 30l. to the parson, which to him is the same thing.

This statement is equally applicable to the landlord, who has received his estate under this charge from his ancestor: the tithe was never the property of such ancestor, or paid for by him, by whatever means the estate may have been acquired. It is also equally applicable, if the landlord stands in the place of the tenant, by occupying it himself.

So far, therefore, there is no injury; but if improvement is made, then, if at all, it may be supposed to take place. Injury there can be none; because the improver knows beforehand on what terms he improves; but tithe will operate as a discouragement to improvement; the improver will lose $\frac{1}{10}$ of the produce of it. If he makes the *titheable produce* of his estate 400l. instead of 300l. the tithe will be worth 40l. instead of 30l.; and therefore instead of receiving an additional 100l. in consequence of his improvement, he will only receive 90l.

This is the plain state of the case, put in the strongest way, and the utmost amount of the discouragement. The improver loses $\frac{1}{10}$ of his *increased produce;* and I therefore wondered at seeing Mr. Mitford, in his pamphlet on the corn laws, state this loſs at 11 per cent. "Full 11 per cent. of the increase (says he,) which the farmers strong box pays for, goes to the parson." I cannot conceive so respectable a man as Mr. Mitford misrepresenting or exaggerating such a fact designedly. But can any thing be plainer, from what I have said, than that the loſs is $\frac{1}{10}$, that is, 10 per cent. In order to make it 11 per cent. he must, I should imagine, have taken the *reduced sum* of 90l. in the above statement, (that is the 100 with the loſs of 10 already deducted) and then calculated the proportion of this *reduced sum* to the loſs itself; which indeed is somewhat more than 11 per cent. It is as if, in stating the proportion of a penny to a shilling, he should first deduct 1d. from 12d. and then take the proportion of one to eleven.

Whether this loſs of $\frac{1}{10}$ on improvements be sufficient to discourage them to any considerable degree, I leave to others to judge; it certainly may prevent some, but I should think not many; chiefly for the following reason. A tenant, able and inclined to make improvements when he takes a lease, will calculate beforehand all these circumstances, and will agree for such a rent only as will enable him to make them with advantage. The landlord may lose somewhat of rent in the first instance; but will receive his estate improved at the end of the term.

And what has, in fact, been the state of landed property and agriculture in this country for many years past? Have not the value and produce of estates gone on improving in a wonderful degree, notwithstanding the *odious* and *oppreſsive tax* of tithes; notwithstanding this species of *slavery*, under which landholders are *groaning?* If we may judge from appearances, it does not seem as if it had operated materially to prevent improvements.

That there are inconveniences attending this sort of property, in its present shape, both to the payer and the receiver of tithe, will be allowed, and it would be very desirable if a proper substitute could be found for it. The interference it occasions between the land and the tithe-owner, has disagreeable consequences, especially between a clergyman and his parishioners, who certainly (if poſsible) ought always to be upon good terms, that the purposes of his office may not be defeated. For this reason chiefly, it will, I believe, be found, that a great majority of the clergy accept a composition considerably leſs than the utmost value of their due, leaving the tithe itself in the hands of the farmer who has produced it. When the laity are poſseſsed of tithe, these considerations do not at all operate; and they may be supposed to exercise a more absolute dominion over this property, which is regarded by them on the same footing with the rest of their family estates, than will be exercised by a ſucceſsion of detached tenants for life, who have peculiar inducements to moderation in the management of it.

To find a proper substitute for tithe, so as to do justice to both parties concerned in it, is by no means an easy thing. It is found that, in the case of the clergy, great objections lie to allotments of land, such as were some years ago generally given by acts of inclosure. The increase of neceſsary buildings, the uncertainty of the tenure under a tenant for life, with the consequent bad management of the land, and the want of proper tenants under these circumstances, are inconveniences which have been much felt, where allotments of land have been substituted for tithe. The injustice of a payment by a stated sum of money is obvious. A corn rent, under some form or other, seems the most promising mode.

# ESSAY XXXIII.

*On the importance of Elastic Fluids in Vegetation, and on the preservation and application of Manures.*

It is my intention in this Eſsay to submit some reflections on the importance of elastic fluids in the proceſs of vegetation, and to apply the principles I shall endeavour to establish to the purposes of agriculture, and more especially to the preservation and application of fold-yard manure. In the latter part I shall only advert to those points which have been either wholly neglected, or not duly attended to by agricultural writers, or by practical husbandmen.

When the animal and vegetable matters produced in our stables and fold-yards are thrown together in a heap, an internal motion soon takes place; the maſs swells and heats, and a variety of elastic fluids are generated: after some time, the fermentation abates, the heap subsides, the heat decreases, and a portion of brownish liquor separates from the rest:

at length the dunghill aſsumes an almost uniform soapy appearance, its temperature falls to nearly that of the surrounding atmosphere, and the extrication of gas is so inconsiderable, that it can only be distinguished by a peculiar odour. In this state, the writers on Agriculture contend, that the putrefactive ferment has ceased, and that a change has by it been effected in the dung, which has fitted it to act as a manure. It requires, however, but little attention to convince us, that this opinion is unfounded, and that the putrefactive proceſs still continues in the state of manure, in the same manner as the vinous action exists in old wine, though it is not very perceptible to our senses. To prove this, it is only necessary to turn the heap, and the fermentation manifests itself afresh; and if this be done under favourable circumstances of warmth, moisture, and due acceſs of air, the proceſs continues until the whole is decomposed. Of the vegetable nothing then remains but a blackish residuum, called *mould*, which is formed of carbone, somewhat fat and oily, and from which water still draws a little extractive matter, and some saline substances. Reduced in the same manner, animal substances exhibit a portion of the same carbone, with some fixed saline substances, such as the phosphats of soda and lime, and a sort of mould, termed *animal earth*, which often retains a little sulphurated or carbonated hydrogen gas, fat, and extract. Now, and not sooner, the putrefactive proceſs is completed.

The question, at what period the putrid ferment ceases, may at first appear of little importance; but, I trust, it will be found connected with many points deserving our attention, and that the establishing of just ideas on the subject may lead to valuable practical inductions. If it be taken for granted, that putrefaction produces a real change in the animal and vegetable matter, and that it is by that change only that they can be fitted to become the food of plants, the farmer will naturally be negligent of what paſses in the early stages of that proceſs, and, considering the elastic fluids that perpetually exhale as mere useleſs vapour, will confine his care to the maſs which has undergone the supposed salutary alteration; but if he view putrefaction, not as an active proceſs producing a real change in the substances subjected to it, but merely as the decomposition of organized bodies; if he be aware that, from its first commencement, a portion of the component parts of his dunghill, (however carefully it may be sheltered,) are inceſsantly exhaling, and that, if the proceſs were supported, the whole would exhale, except the trifling residuum before spoken of, he will, no doubt, conceive that the more volatile parts are also deserving his notice, and endeavour, as far as poſsible, to retain them. The following view will convey a sufficiently clear idea of the subject.

Whatever variety of substances we find in vegetables, such as oils, salts, extractive matter, &c. it is certain that they are all originally derived from the food of plants. The articles of which their food consists are, by the vital energy, formed into new combinations, and while that energy continues to act, those combinations are preserved. No sooner is the vegetable dead, than a tendency to decomposition ensues; the union is soon diſsolved, and the more volatile ingredients mingle with the atmosphere in the form of elastic fluids. Nothing can be more clear than that these volatile parts are applicable to the purposes of vegetation; for what, in truth, are they? If the various ingredients of vegetable bodies be no more than the food of plants moulded into new combinations by their living powers, and if putrefaction be only the diſsolution of those combinations, then it will follow, that what is let loose by that decomposition, is, in reality, the food of plants: neither ought we to suppose that the parts which thus escape, are in small quantities, and therefore unworthy our attention; for the proceſs of putrefaction shows, beyond a doubt, that by far the greater part of animal and vegetable substances which are subjected to putrefaction, aſsumes the form of elastic fluid. I am now speaking of putrefaction conducted under favourable circumstances: for where there is a deficiency of caloric, and redundancy or want of moisture, the new combinations will be made in different proportions; and much that would (if caloric had abounded,) have united with it, and assumed the gaseous form, will, under these circumstances, be found in a more fixed state. Whatever difference is observable in the decay of vegetable or animal matter, under different external circumstances; may be explained by an attention to these points.

As vegetable matter, when its organization is destroyed, chiefly aſsumes the aerial form, I have long thought it probable, that the food of plants is, in a great measure, inhaled by them in that form, or, in other words, that elastic fluids are the chief food of plants. As this opinion, if rendered probable, would strongly enforce the neceſsity of that attention to the gases of our dunghills, which it is the chief object of this Eſsay to recommend, I shall here submit the reasons which have induced me to adopt it.

1st*, It has been found, upon examination, that the fertility of soils is in proportion to the elastic fluids they contain.

2dly, Carbone, which is almost the only fixed ingredient of plants, and is by far the most abundant, is insoluble in water, or in the acids which are found in soils; it is only, therefore, as united with azot or oxygen, in the forms of carbonated azotic gas, or carbonic acid gas, that it can enter the absorbents of plants. The extreme tenuity of those veſsels renders it impoſsible for it to enter them in the state of the most intimate diffuſion.

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* See Mr. Arthur Young, as referred to by Kirwan.

3dly, We know that plants live and thrive in many of the chemical airs, and we have also undoubted proofs that they decompound them: the veſsels, therefore, of plants are adapted to act upon elastic fluids, and (if I may be allowed the term,) to digest them.

4thly, The primary substances from which all vegetable matter is formed, are all found in the state of gas, viz. azot, hydrogen, oxygen, and carbone.

5thly, It is in favour of this opinion, that it affords us a ready explanation of the manner in which heat promotes vegetation; as, without its agency, no substance can aſsume the gaseous form.

6thly, Even water, which has been supposed the sole food of plants, is most favourable to vegetation, when applied under circumstances which produce its decomposition: hence the vigorous growth of plants in warm moist airs, in an atmosphere loaded with the electric fluid, and in copious dews. Even when water is artificially applied, it is most beneficial when it is exposed to decomposition by being made to ripple over an extended surface of soil, as in the practice of irrigation. On the same principle, we can explain why cold rain rather checks than invigorates vegetation.

7thly, Perhaps the very extensive and complex apparatus of air-veſsels which we find in plants, may be adduced as an argument in favour of our theory; if it be admitted, we shall consider them as the *primæ viæ*, or intestines of plants, as the digestive organs in which they first elaborate their food, and adapt it to the various purposes of their economy.

8thly, If vegetable matter be made to decay in a low temperature, and drenched with a redundancy of water, it is found, when rotted, to be of little or no use as a manure: under these circumstances, only a very small proportion of gas is generated. If the same matter fall to decay without a due proportion of moisture, or, if a proper quantity of moisture being present, there be a deficiency of heat, the decayed maſs is, in the same manner, found inactive as a manure; it is only where the decomposition takes place under circumstances favourable to the formation of elastic fluids, that it is effectual in favouring vegetation.

These reasons have induced me to believe, that elastic fluids are probably the chief food of plants; I shall therefore next consider how far this view of the subject ought to influence our practice.

The first particle which flies off from a putrifying vegetable, is as completely fitted to become the food of plants, as if the whole had thoroughly fermented; its former combination is diſsolved, and it is prepared to combine anew: It follows, therefore, that we ought, as far as poſsible, to retain the volatile parts, which are thus inceſsantly wasting. But although this conclusion be sufficiently evident, it is very difficult to carry our views into execution. Some waste is unavoidable; the moment that dung is dropped, a part is separated in the form of elastic vapour, and is lost. But this is not all. In order to subject the animal and vegetable matter, which is swept from our fold-yards, to putrefaction, it is neceſsary to collect it in considerable heaps: it is some time before these can be collected, and while that is doing, no precaution can be taken. When it is so collected, were we, without delay, to plough it into the soil, all fermentation would cease; and the same would happen, were we to prevent the admiſsion of air. These difficulties cannot be wholly overcome, but they may be considerably obviated.

We know there is a tendency to combination between soil and gaſses, which are generated in putrifying substances; by this combination soils are fertilized, and it is in consequence of it that the farmer derives benefit, by adding soil to his compost. If, then, we can bring the airs which arise from our dunghills into close contact with soil, we may reasonably suppose, that no inconsiderable portion of them will be retained by it. For this purpose, let a portion of surface soil, or any light earth, be strewed, as soon as may be, on the dunghill; if the quantity thrown on be not too large, it will not check the putrefaction: after a time, let this soil be mingled with the dung, or, if the fermentation should not be active, let it be thrown off, and heaped up beside it, and then another portion be laid on the dung, as at first. Thus, by degrees, we shall form the most valuable materials for composts, and profit by those active principles which are, in the present practice, inconsiderately wasted; peat-earth will answer better than any other for this purpose, both as the lightest, and as it abounds in vegetable matter, which, under this treatment, will be converted into a valuable manure. As it is evident, that the sooner dung is fitted for use, the more profit it will yield to the farmer, and the leſs it will be wasted, it is well worth attending to the means of accelerating its putrefaction. In warm weather, sprinkling the maſs now and then with water, will have a good effect in this point of view, as is well known to gardeners; and it is probable, that the addition of a portion of rotten dung to the recent heap might have the same effect, upon the same principle that yeast communicates its peculiar action to farinaceous substances.

Besides these precautions, it is worth inquiring how far it is neceſsary for dung to be in so advanced a stage of putrefaction before we use it. I have already observed, that if it be ploughed into land before its fermentation is somewhat advanced, the proceſs will be stopped; but when it has once pervaded the maſs completely, we may mingle it with the soil without any such effect, provided the field be duly prepared to receive it. It must be ploughed and harrowed in immediately;

and I have the authority of one of our most intelligent and experienced farmers for aſserting, that half-rotted litter, used in this manner, is of more advantage than it would be, if kept at the farmstead until thoroughly rotted. It may be proper to remark, that the richer soils are, or, in other words, the more elastic fluids they contain, the more favourable they are to the continuance of the fermentation of the dung ploughed into them; and also that the soil should be previously well broken down and lightened; to this I alluded, in stating the neceſsity of the land being duly prepared to receive it.

I have thus far treated of the preservation of manure, and shall now state some things concerning its application.

If elastic fluids are of so much importance to vegetation, it will follow, that manure ought to be applied under circumstances which favour their generation: these chiefly occur in spring, after the graſs has covered the land in some degree, or the annual crops attained some height, that the dung may be shaded from the sun, and not exposed to too much drought; or else early in the autumn, after the hay crop is removed, and the aftermath has made its first shoot. These will, I have no doubt, be found decidedly the best times; but if the latter be chosen, the farmer will loose the eatage of his aftermath, a circumstance which will render it generally unadvisable in seasons when fodder is scarce, but which, at other times, will greatly contribute to the improvement of the land which is manured. Besides its being unfavourable to the generation of elastic fluids, there is another reason against spreading dung in winter, and that is, that as vegetation is then extinct or languid, plants are not capable of benefiting by the nourishment provided for them. In the warmer seasons, on the contrary, their growth immediately becomes more rapid, no part of the manure is allowed to escape, and at once a more immediate and more ample return is made to the farmer.

I shall close this Eſsay by observing, that it would be difficult to devise a worse manner of using dung than that which is almost universally practised in this country on graſs-land. When a severe frost has bound up the land in a state of impenetrable cohesion, perhaps when snow has covered it, farmers wheel on their dung. While the frost lasts, the land can derive no advantage from the manure; and when a thaw supervenes, it is evident that the wash from melting snow, or from the rains which generally fall in such weather, must deprive the maſs of every part that is soluble: the ground, in the mean time, retains the frost for many days, and is therefore incapable of absorbing the wet which falls upon its surface; and even when the influence of the milder air has reached it, it can imbibe but little, being in general previously filled with water, and the quantity which flows over it being too great for the soil, under any circumstances, to drink up. There can only be one reason assigned in favour* of this destructive custom, (for the plea of convenience cannot be admitted in a case of such importance,) and that is, that manure, when spread early in the winter, guards the roots of graſses from froſt. This I have heard alledged, but it is an error. Perennial graſses do not suffer by froſts, as is well known to every farmer; and if broad clover, which is a biennial, be deſtroyed by froſt, we have good authority to believe, that it is no leſs certainly injured by the application of manure, when it is not in a ſtate of vegetation. Such is, at leaſt, the aſsertion of Mr. Somerville, in the chapter on manures before quoted. But, ſhould this be diſputed, it will ſtill remain true, that where it is neceſsary to guard the roots of graſses from ſevere cold, it will be beſt done by manuring at the times already recommended, and by freeing the paſture early, and leaving it tolerably rough in the autumn. It is therefore to be hoped, that this ſlovenly and unthrifty uſe of dung will not long be perſevered in by any man who is capable of looking to a better authority than that of long-eſtabliſhed cuſtom.

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* Farmers spread their dung in winter, because it is a season when their servants and horses are least employed; and they do it in frost, that they may not injure the sward: but the sward will not be injured, if they apply their manure in summer; and it is surely a bad excuse for doing any thing at an improper time, to say that you had leisure to do it.

### *Explanation of Scientific Terms uſed in the foregoing Eſsay.*

*Gas.*—A term firſt uſed by Van Helmont. It comprehends every elaſtic fluid which aſsumes the form of air. Whenever a body aſsumes this form, it is in consequence of its being combined with the matter of heat; by the French chemists termed *caloric*.

*Carbone.*—Pure coal, or rather charcoal. Common charcoal contains some incombustible earth, and certain salts, besides carbone.

*Oxygen*—combined with the matter of heat, forms vital air. 0,28 parts of the air which we breathe consists of vital air, so called, because it is the only part of the air which conduces to life. Oxygen is also the principle which generates acidity, and from this circumstance it derives its name, which is from the Greek ὀξυς acid, and γεινομαι to generate.

*Azot* and *Azotic Gas.*—Azotic gas forms the remaining 0,72 parts of the air we breathe. When unmixed with oxygen, it extinguishes fire, and destroys life: it derives its name from the latter circumstances, being from the Greek privative particle α, and ζωη life.

*Hydrogen.*—From ὑδωρ water, and γεινομαι to generate, so called because it conduces to the formation of water: water indeed consists of

0,85 oxygen, and 0,15 hydrogen. Hydrogen gas is the fire damp of coal-mines.

*Carbonic Acid Gas.*—It consists of 0,72 oxygen,and 0,28 carbone. This gas was long known by the name of *fixed air*; it is the choak damp of coal-mines; fermenting liquors emit it in large quantities; and to its escape is owing the effervescence which takes place when acids are poured on lime, chalk, or marl.

*Carbonate of Lime.*—Lime combined with carbonic acid, otherwise fixed air. Lime is always combined with fixed air before it is burnt; and although the fire deprives it of its fixed air, as soon as it cools it begins slowly to reabsorb it. Carbonate of lime is often called *effete lime.*

*Oxalic Acid.*—Acid of sorrel. Wild sorrel, called in this country *sour dock*, generally prevails in lands which have been *soured* by stagnant water.

*Calcareous.*—A term applied to all earths which effervesce with acids. Such are marble, lime-stone, chalk, &c. Gypsum, shells, and bones chiefly consist of this earth, and it is from it that marls derive their fertilizing powers.

# ESSAY XXXIV.

## *On the Norfolk Husbandry.*

ABOUT sixty years ago, a great part of the county of Norfolk was in sheep walks, rented only at about eighteen-pence an acre; and even within my memory, many thousand acres were in this state, which are now turned into the finest farms, and let at twenty shillings per acre.

The late amazing improvements may be attributed to various causes. Among others, the following have not been the least operative.

1*st*, Inclosing our heath and waste lands; folding sheep; and the most extensive use of marl and clay, on sandy soils especially.

*2dly*, By the general introduction of turnips, well hand-hoed; of clover, ray-graſs, and buck-wheat, and an excellent course of crops.

The farms being generally large, and held on long leases, the tenants were thereby enabled to lay out their money freely in improvements, without being in danger of losing the advantages arising from their cost and labour.

We poſseſs one natural advantage, which, perhaps, cannot be found in an equal degree in many other counties. In all our sandy lands, wherever we dig, we find excellent yellow marl, or clay. The goodneſs of the marl is determined by its subsiding quick in water. On the first discovery of marl, our farmers spread it in larger quantities than at present; few laid on leſs than eighty loads per acre; but for near thirty years past, the general quantity has been from forty to fifty loads (or tons) per acre. The effects of this quantity will last twenty years; and then half as much more added will restore fertility to the soil. We have, however, found, that on lands wholly sandy, clay has had a better effect than marl; but where the soil is a mixture of sand and loam, or of sand and gravel, marl does excellently. It is not, however, to marl and clay only, that our improvements are owing. Our sheep are folded both summer and winter. We fatten beasts during the winter on turnips in our farm-yards, in which we also keep a large stock of swine. Our stubbles are cut, and, with large quantities of straw, converted into manure. Oil cake is also laid on wheat lands to the amount of two guineas per acre. These manures, freely used, have proved the sources of wealth to thousands.

The usual course of crops among our greatest and best farmers, is, 1st, Turnips; 2d, Barley; 3d, Clover, or clover and ray-graſs; 4th, Wheat. This course has, of late years, become very general, and keeps the soil clean. We manure for turnips if poſsible, and also for wheat. Sometimes our clover is extended to three years, but not frequently. Of late, especially, our clover often fails the third year, and sometimes the second, if the land be wet; for wherever the water stands in the winter or spring, clover turns black and decays. Our farmers agree in the opinion, that if turnips are sown on a well-conditioned fallow, and twice hoed, and the land ploughed three times for barley, the clover may remain at least two years without giving a foul crop of wheat, especially as our wheats, on clover lays, are, of late, almost wholly *set*, and more easily kept clean than when sown broadcast. We set from two to three pecks per acre, and find great advantage from the practice—the expenſe of ſetting by hand is, from ſix to eight ſhillings per acre. On our fallows, we plant with Mr. Blancher's drill-plough, at leſs than half the expenſe, and with equal regularity and ſucceſs.

The Norfolk husbandry is quite a ſyſtem, every ſucceſsive part of which is dependant on the foregoing, and therefore it will not admit of much variation.

As every thing depends on the ſucceſs of turnips, *their* ſucceſs depends on good hoeing. They are the only fallow in our uſual courſe: nor can we change them for a *mere* fallow, becauſe the ſheep, kept to fold, and to feed off the clover and ray-graſs, would then ſtarve. We give four ploughings for turnips, and hoe them well twice. They often, with this culture, prove worth five guineas an acre. The principal part of the crop is drawn and carried into farm-yards for fattening beaſts, the remainder we feed off with ſheep and lambs, which clear the land of every part of them.

We generally mow the firſt and ſecond growth of clover; not merely on account of the hay, but because, by repeated experience, we are convinced the wheat which follows is far better than it would be after feeding.

Soaper's ashes are laid on strong wet lands with great succeſs; and also on pastures as a top-dreſsing in the beginning of April. Malt-dust and soot are used on meadows, and answer well; the latter is purchased at high prices from Norwich.

The winter food of cows is chiefly turnips and straw, in the farm-yards, which are kept well littered with chopt stubble and straw.

We reckon six horses neceſsary for one hundred acres of arable; and with two in a plough, we till two acres in a day, five or six inches deep. Stubbles for fallow are ploughed in during autumn—this also destroys the weeds.

A good dairy-maid with us will take proper care of twenty cows; and to every cow our best farmers keep one hog.

The common mode of estimating the expense of taking a farm is, that three rents will about stock it, or four very completely.

In some parts of this county, considerable quantities of cole-seed are raised; we hand-hoe it like turnips, and by that means nearly double the value of the crop.

Our broad clover sometimes produces near three tons the first cutting per acre. Nonsuch, ray-graſs, and small white clover, are an excellent mixture to lay down dry lands with; and yield the sweetest hay.

Near the coast great quantities of sea-weed, or ooze, are collected, and used as manure to good purpose. We mix it in compost with earth and lime, or marl and dung, for one year, and then lay it on arable land. Our best farmers beat down thistles and nettles, and mow the weeds in their borders, ditches, and the adjoining roads, lanes, and commons, before they seed, and burn them to ashes, or carry them into the fold-yard; the ashes are used as a top-dreſsing for their meadow-lands. This is excellent management, and worthy of general imitation; for it saves infinite labour the succeeding spring in the fields adjoining.

Most of the farmers round Norwich, carry dung to the distance of ten or twelve miles.

[illegible] waggon for two shillings, or a [illegible] three horses for one shilling.

A great deal of buck-wheat is sown here as preparation for wheat, and answers well. Six pecks are sown per acre, and the average produce is from three to four quarters. The price is generally the same as that of barley, and it is an excellent fattening for swine and poultry.

Many of our farmers have cultivated lucern with succeſs on good rich lands. On a poor soil it seldom answers well.

Two-wheeled ploughs are used in general, as being most easy and expeditious; but in heavy lands they use swing-ploughs, and two horses always do the work. We should smile at the folly of putting four horses to a plough in *any soil*, because we know it to be unnecessary, except where the land abounds with stone.

# ESSAY XXXV.

## *On the Application of Chemistry to Agriculture.*

AGRICULTURE is undoubtedly the most ancient and honourable of all the arts, since it dates its origin from the highest antiquity, and appears to have been coeval with the first parents of the human race. Though it has received all the improvements of a long succeſsion of ages down to the preſent time, whence is it that its progreſs towards perfection has been much slower than that of many others of a far more modern date?—The chief causes which have retarded its advancement, seem to be the three following:—

1st, The extreme difficulty of the study of Agriculture.

2dly, The want of proper masters to unfold its principles, as in other branches of Experimental Philoſophy. And, 3dly, The great reluctance of farmers to quit the beaten track.

So complex is the study of Agriculture, that it involves a multiplicity of objects of the most abstruse and recondite nature, which never can be thoroughly understood without a previous knowledge of many other arts, and particularly of Chemistry. And yet this important science has been uniformly committed to the sole management of the illiterate part of mankind. These being unable to learn, for want of persons qualified to teach, have obstinately purſued a routine of random practice, in imitation of their foreſathers, without any settled principles. Innumerable errors have thus been tranſmitted from one generation to another, under the fallacious appearance of being the result of long experience. Can we wonder then that the theory and practice of Agriculture are yet far, very far, from having reached the summit of perfection? Chemistry indeed has not till of late years been applied to Agriculture and the economical arts, though the principal operations of each evidently depend on chemical principles.

It is not to be expected that every husbandman should be a profound chemist; but I will venture to say, that every gentleman who wishes to improve his estate, and to advance the art of Agriculture, ought to be well versed, at least, in the principles of philosophical chemistry; without which he can neither conduct experiments properly, nor explain the several phenomena satisfactorily which result from them.

The uses which chemistry may be of in Agriculture are great and extensive, but my present bounds will only permit me briefly to mention a few of them.

To this art it belongs, to distinguish the sundry kinds of earth, according to their natures and proportions;—to determine which of them are the fittest for different purposes;—to ascertain the different qualities of the various sorts of manures, and to point out proper methods of applying them;—to discover the best method of improving a barren soil;—to effect, by a suitable mixture of earths, what is not to be accomplished by manure alone.

The earths which most commonly occur, are clay, sand, and calcarious earth, none of which alone is adapted to the support of vegetables. Hence in a good soil, they are therefore generally found mixed, at least two of them, together with a portion of decayed vegetable substances.

Clay retains moisture the best; after clay, calcarious earth; sand dries rapidly. Hence it follows, that from the different proportions in which they are mixed, result so many different capacities for retaining water. Hence too the inferior as well as superior strata of the soil ought to be examined, as well as the mean state of the weather with respect to drought or moisture, and opportunities of watering, &c. For the best soil will prove sterile without a due proportion of moisture.

To render land capable of producing a ſmall crop of grain, requires no great skill; but to cause it to yield the greateſt poſsible crop, demands no common management. Is it not disgraceful to behold the execrable husbandry which prevails in some parts, where it is no unusual thing to see corn and weeds struggling together for the superiority, till the latter, gaining the ascendency, stifle the meagre crop, and spread triumphantly over all the neighbouring grounds!

To chemistry it appertains to suggest suitable means for preserving grain from smut, blights, or mildew; also for destroying, or driving away insects, reptiles, and other noxious vermin, which are wont to prey on fruits, seeds, or vegetables.

When the products of Agriculture are at length obtained, the aid of chemistry is still eſsentially neceſsary towards their preservation, and the means of fitting them for the various purposes to which they are destined.

Grain, and farinaceous vegetables, are convertible into flour, bread, starch, malt, &c. In proportion to the saccharine matter contained in them, they become subjects of the vinous and acetous fermentation, and hence the operations of baking, brewing, the making of wine, cider, vinegar, &c. are so many chemical proceſses; which, for want of the requisite stock of knowledge, in many cases either fail altogether, or are carried on with little advantage.

The preparation of flax and hemp for sundry uses, and the operation of bleaching and whitening linen; also of preserving wood from putrefaction, and preparing other vegetable productions for various economical purposes, depend all on chemical principles.

The productions of the animal kingdom afford a variety of raw materials which enrich the farmer, and which, by suitable management, constitute no inconsiderable share of the national wealth. Such as meat, eggs, milk, butter, cheese, honey, wax, tallow, hides, &c. All which, by chemical art, may be preserved in a sound state for a considerable length of time, or even sometimes restored, in a great measure, after corruption has begun to take place, They may also be further improved, and converted to a variety of economical uses to the highest advantage, if their chemical properties are properly understood.

An eminent author has very justly observed, that the application of chemistry to arts and manufactures, is an object of a very interesting and extensive nature; because many of them consist of a series of chemical proceſses from beginning to end, others only in certain stages; the rest being performed by mechanical operations. Though arts and manufactures might owe their first origin to chance, or random experiments, yet the improvement and perfection of them must ultimately depend on certain facts and principles, which it is the province of chemistry to illustrate and explain.

Private interest, indeed, has long checked the progreſs of the arts, and selfishly monopolized the most lucrative employments, by casting a veil of secrecy over the different proceſses; but chemistry aſsists us in drawing aside the veil, and oftentimes too in accomplishing the end, by more simple and efficacious means.

In short, from the foregoing observations it appears, that both in public and private manufactories, and various articles of rural economy, a multitude of operations are continually going on, which, undoubtedly, depend on chemical principles. It were, therefore, earnestly to be wished, that an accurate inquiry into the present state of the arts throughout the kingdom, were to be undertaken and repeated at certain intervals, with a view towards their improvement. This would supply many curious and useful facts, which before were not known, except in manufactories. Chemistry, in its turn, would unfold the principles on which the various operations are founded, concerning which even the artists themselves are generally observed to be groſsly ignorant.

It seems evident, that no material change can be wrought in bodies, but either by separating something from them, or combining something with them; but it is by chemical attractions, that both separation and combination are performed. Consequently it is from the accurate knowledge of chemical laws, that the clearest lights, and ablest aſsistances, are to be obtained.

Knowledge, says the illustrious Verulam, is incomplete, and scarcely deserves the name, unleſs it enables us to explain the several phenomena. Is it not surprising then, considering the rapid progreſs which chemical science has been making for some years past, that its profeſsors have not till very lately pointed out its applications to the improvement of Agriculture and rural economy? The late ingenious Dr. Lewis, in his Philosophical Commerce of the Arts, suggested many useful hints towards the improvement of various arts and manufactures by chemical inquiries: And it is much to be regretted, that these have not been pursued, and extended by his succeſsors, with a particular reference to Agriculture.

A course of lectures on this plan, delivered in a plain, familiar style, would be a great national acquisition, and convey the most interesting information to various ranks of men, and particularly to the country gentleman, the intelligent farmer, and curious artizan. Few there are, it is hoped, but will readily spare a small portion of their time, to partake of so useful, so elegant an amusement.

If a scheme of this nature ever was neceſsary, it seems to be peculiarly so at this juncture. Since we have been stript of our American colonies, and many sources of our wealth and commerce been diverted into other channels, it surely behoves us to employ those which remain to the best advantage. If any thing can enable us to support our present enormous burdens, or maintain our national character, it must be *a strist attention to the improvement of Agriculture, and useful Arts.*

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